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VAN DER GOOT (P.). **De biologische bestrijding van de cactus-plaag in het Paloe-dal (Noord-Celebes).** [The biological Control of Prickly Pear in the Palu Valley, North Celebes.]—*Meded. alg. Proefst. Landb.* no. 43 (*Meded. Inst. PlZiekt.* 98), 17 pp., 4 pls., 1 fig., 10 refs. Buitenzorg, 1940. (With a Summary in English.) [Recd. 1942.]

In view of the fact that abandoned rice-fields and pasture lands in the Palu valley, a district in North Celebes with a very low annual rainfall of 12–30 inches, were being rapidly overgrown by a prickly-pear, *Opuntia nigricans*, a consignment of *Dactylopius opuntiae*, Ckll. (*tomentosus*, auct.) was obtained in December 1934 from Australia, and this Coccid was bred in a greenhouse at Buitenzorg, Java. It completed a generation in 48–63 days on *O. nigricans*, but required 80 days in one instance on *Nopalea coccinellifera*, a cactus sparsely distributed throughout Java, and did not survive on *Opuntia monacantha*, which is common on the northern coast of Java. In March 1935, distribution of infested material in Palu was begun. Care was taken to ensure that the material sent from Java was free from *Cryptolaemus montrouzieri*, Muls., which was present in the greenhouse [and has been introduced into other parts of Celebes (*R.A.E.*, A **26** 337)]. *D. opuntiae* spread rapidly on *O. nigricans* in all the areas in which it was liberated, and many plants were dying off by May 1936, while by the end of 1939 the dense cactus vegetation had disappeared from the valley, giving place to a new growth of *Leucaena glauca* and other plants. Isolated cactus plants in sunny places proved the most difficult to kill as the Coccid appeared to develop more slowly on them. No natural enemies of it were observed in Palu.

PHILLIPS (J. S.). **A Search for Parasites of Dasynine Bugs in the Netherlands Indies.**—*Trans. R. ent. Soc. Lond.* **91** pt. 5 pp. 119–144, 16 figs., 6 refs. London, 1941.

Since Coreids related to *Amblypelta cocophaga*, China, which causes immature nutfall of coconuts in the Solomon Islands [*cf. R.A.E.*, A **29** 325], have been recorded from the Netherlands Indies, a search for parasites of these bugs that might be suitable for introduction against *A. cocophaga* was made in Java between December 1936 and February 1938. The Coreids mainly dealt with were *Homoeocerus lucidus*, Wlk., which feeds on *Albizzia*, and *Dasynus manihotis*, Blöte, which also feeds on *Albizzia* and occasionally attacks cassava [**23** 678]. Investigations were carried out on their bionomics and the parasites that attacked them. No parasites of the adults or nymphs were obtained, but five parasites, comprising undescribed species of *Ooencyrtus* and *Tetrastichus*, *Hadronotus homoeoceri*, Nixon, a species of *Anastatus*, possibly *A. dasyni*, Ferrière, and *O. malayensis*, Ferrière, were bred from eggs of *Homoeocerus* and the last three of them from eggs of *Dasynus*. The factors affecting their possible value against *Amblypelta* in the Solomon Islands, such as the effect of the different physical environment, the length of the life-cycle, the sex-ratio, the reproductive capacity, the natural enemies and the host-range are discussed. All except *Tetrastichus* were introduced into the Solomon Islands, and breeding experiments were carried out there and in Java. *Ooencyrtus* sp., *Hadronotus homoeoceri*, *Anastatus* and *O. malayensis* were all reared on *Homoeocerus lucidus* and *H. marginellus*, H.-S., in Java, while *Ooencyrtus* sp. was also bred on another Coreid and *Nezara viridula*, L., and *O. malayensis* on *Physomerus grossipes*, F., two other Coreids, and three Pentatomids, including *N. viridula* and *Chrysocoris javanus*, Westw. (*atricapillus*, Guér.). All four parasites were reared on *Amblypelta cocophaga* in the Solomon Islands, and the other hosts parasitised included *Axiagastus cambelli*, Dist., which is commoner on coconut than is *Amblypelta cocophaga*, by *O. malayensis* and *Anastatus*. *Ooencyrtus* sp. was also bred on two other Coreids (one in Queensland) and a Pentatomid,

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Hadronotus on another Coreid, *Anastatus* on four other Pentatomids and *O. malayensis* on these and on other Coreids. The rearing technique and method of transporting the parasites are described.

Nearly all the Dasynine bugs studied have become pests of cultivated crops. The attack is usually made by small numbers, and the damage inflicted is disproportionately great, suggesting that the punctures are toxic to the crop, though they are only very slightly, if at all, toxic to the original food-plants. *D. manihotis* appears to be incompletely adapted to its new food-plant (cassava), as also are probably *D. fuscescens*, Dist., and *Amblypelta lutescens*, Dist., which attack banana sporadically in Queensland. *A. cocophaga* appears to have become adapted to coconut in the Solomon Islands, but attacks it only in the newly planted European plantations, to which it migrates from the bush. The food-plant relationships of 8 Dasynines and the localities in which they occur are shown in a table.

PENDLETON (R. L.). **Some Results of Termite Activity in Thailand Soils.**—*Thai Sci. Bull.* **3** no. 2 pp. 29–53. 1941. (Abstr. in *Soils & Fertil.* **5** no. 3 p. 105. Harpenden, 1942.)

In many parts of Thailand, the millions of mounds constructed by termites are of considerable benefit to farmers, since they provide small plots of modified soil that can be used for growing trees and " upland " crops in rice districts. The nature and distribution of termite mounds and chemical and physical analyses of ten mounds from widely different parts of Thailand and of their associated normal soils are reported. The most striking chemical feature of the mound soils was the accumulation of calcium carbonate in the base of the mounds, although the normal soils of the places where the samples were taken were moderately to strongly acid. The higher fertility of the mounds is due to their higher pH and plant-nutrient content, the better moisture relationships, and the position of the upper portions of the mounds above the water-level on the paddy land.

It is rarely advisable to destroy the mounds, since when this is done and the soil distributed about the former site, the productivity of the land remains very irregular and the growth of tobacco may be prejudiced. In one district, however, other fertility relationships seem to prevail. Recommendations are made for the complete removal of the mounds where this is considered advisable. No suggestion is made regarding a mechanism to account for the differential accumulation of calcium in the mounds or for the other chemical and physical differences noted in the mound soil.

CUTHBERTSON (A.) & MUNRO (H. K.). **Some Records of Tachinid Parasites and their Insect Hosts in southern Africa.**—*Trans. Rhod. sci. Ass.* **38** pp. 88–118, 31 refs. Johannesburg, 1941.

Lists are given of 85 Tachinid parasites that have been recorded from the Union of South Africa or Southern Rhodesia and one from Portuguese East Africa, showing their insect hosts, and of the hosts, showing the Tachinids that attack them.

In an appendix by C. H. T. Townsend, the generic name *Curranomyia* is proposed for *Rhodesina*, Curr., which is preoccupied by *Rhodesina*, Mall.; the genotype is *Rhodesina parasitica*, Curr. [*R.A.E.*, A **27** 567].

WHITEHEAD (T.) & WOOD (C. A.). **Aphid Transmission of Strawberry Viruses.**—*Nature* **148** no. 3759 pp. 597–598, 1 ref. London, 1941.

British workers with strawberry viruses have failed to obtain transmission of Fragaria virus 1 (yellow edge) [*Marmor marginans* of Holmes] or Fragaria virus

2 (crinkle) [*M. fragariae* of Holmes] by Aphids other than *Capitophorus* (*Pentatrichopus*) *fragariae*, Theo. In experiments at Bangor, *Macrosiphum solanifolii*, Ashm., *M.* (*Aulacorthum*) *solani*, Kalt., *Myzus persicae*, Sulz., and *M. circumflexus*, Buckt., failed to transmit any virus from severely diseased plants of the variety Royal Sovereign, and *M. ornatus*, Laing, which was not tested with the yellow edge virus, failed to transmit crinkle. All these Aphids have been found on strawberry in North Wales, though *M. circumflexus* was represented by a single individual only. Of two species of *Capitophorus* (*Pentatrichopus*) tested as vectors of crinkle, but not occurring on strawberry in nature [*R.A.E.*, A **29** 28], *C. potentillae*, Wlk., did not transmit it, but *C. tetrarhodus*, Wlk., transmitted it from Royal Sovereign to *Fragaria vesca* in 1940 and 1941, the resultant symptoms being indistinguishable from those induced by means of *C. fragariae*.

WIESMANN (R.). **Ersatzstoffe für die Arsenmittel im Pflanzenschutz. I. Versuche mit Phenothiazin, Schwefelstickstoff und Sporein im Obstbau.** [Substitutes for Arsenicals in Plant Protection Work. I. Experiments with Thiodiphenylamine (Phenothiazine), Sulphur Nitride and Sporein in Orchards.]—*Landw. Jb. Schweiz* **55** pt. 6 pp. 657–675, 4 figs., 22 refs. Berne, 1941. (With a Summary in French.)

The author emphasises the desirability of discovering effective substitutes for arsenical insecticides and describes experiments in Switzerland on the use in sprays of thiodiphenylamine (phenothiazine) [*R.A.E.*, A **23** 652], sulphur nitride [**27** 78] and Sporein, a French preparation of the dried spores of bacteria pathogenic to Lepidopterous larvae [**28** 500, etc.].

Thiodiphenylamine was used at a concentration of 0·5 per cent. with the addition of the same amount of soy-bean flour or proprietary preparations to correct its poor wetting power and tendency to settle. None of these reduced its effectiveness. When larvae of *Operophtera* (*Cheimatobia*) *brumata*, L., *Hyponomeuta padellus malinellus*, Zell., and various unnamed Tortricids were fed on apple leaves sprayed in the laboratory, complete mortality was given by leaves sprayed 1 day previously and, except in one case, on those sprayed 3 days previously, but toxicity decreased markedly after 5 days, apparently because of exposure to the air. Complete mortality was also given by apple leaves picked 1 day after the trees had been sprayed, but the percentage mortality decreased progressively after 7 and 14, and was almost 0 after 21 days, whereas calcium arsenate gave complete mortality throughout this period. Thiodiphenylamine was about as effective as calcium arsenate against adults of *Phyllobius oblongus*, L., but gave complete mortality only after 6–10 days, possibly owing to a repellent effect. In field tests in which apple trees that had received no treatment were given a calyx and one cover spray of thiodiphenylamine, some control of larvae of *Hyponomeuta* was obtained, but none of *Cydia* (*Carpocapsa*) *pomonella*, L. This may have been due to the length of time over which the larvae hatch and the rapid loss of toxicity of the insecticide. A spray containing 0·4 per cent. sulphur nitride and 0·4 per cent. bentonite was quite ineffective against larvae of *O. brumata* and *H. p. malinellus* placed on sprayed apple leaves, and the latter were badly scorched.

Sporein was used in the laboratory at a strength of 1 per cent. with 0·1 per cent. of a wetting agent, and gave complete mortality of larvae of *O. brumata* and *Hyponomeuta* on sprayed leaves after 3 days. Its effectiveness was not increased by doubling the concentration or reduced by the addition of lime-sulphur, which improved its adhesiveness. When leaves from apple trees sprayed in the field were picked after various intervals and fed to larvae of *O. brumata*, complete mortality was given by those sprayed 2 and 4 days previously and almost complete mortality by those sprayed 8 days previously, but leaves picked after 16 days caused no mortality, possibly because the spray had been

washed off by rain. When 14 nests of *Hyponomeuta* were sprayed in the field all the larvae were dead after 4 days. The spray gave no control of *C. pomonella* in the field.

COTTAM (R.). **A Chrysanthemum Pest in Cheshire.**—*Northw. Nat.* **16** no. 4 p. 325. Arbroath, 1941.

BRITTEN (H.). **A Braconid Parasite of *Psila nigricornis*, Mg.**—*T. c.* p. 325.

The author of the first of these notes found that the death or poor growth of chrysanthemums in Cheshire was due to attack by *Psila nigricornis*, Mg., the larvae of which bore in the underground stems, cutting off the water and sap supply. This fly appears to have at least two generations a year. Both small and fully grown larvae were found during the winter, and the pupae occurred in the soil from late autumn till the end of May. The author of the second note bred *Dacnusa postica*, Hal., from pupae of the fly received from Cottam. This Braconid also parasitises *P. nigricornis* on carrots.

GUNN (D. L.). **Pests in Grain and other stored Products.**—*J. Inst. Brew.* **47** no. 5 pp. 130–135, 1 ref. London, 1941.

The pests of stored grain in Great Britain of most concern to maltsters and brewers are species of *Calandra* in barley, *Tribolium* in barley and malt, *Trogoderma* in maltings, and *Ptinus*, *Niptus* and *Trigonogenius*, which are general pests of stored materials. The ways in which grain becomes infested by these pests are discussed on the basis of a recent report [*cf. R.A.E.*, A **29** 186]. Infestation of barley and malt is important not only on account of the cost of the material consumed and the difficulty of replacing it, but also owing to the interference with smooth running of the malting processes owing to such factors as failure of germination, souring of extract, and rise of water content caused by infestation. The author recommends that malt and barley arriving at the breweries should be dressed, and kiln-dried in drums at temperatures just too low to damage the barley, to kill all stages of the remaining insects ; that sacks should be heated to eliminate infestations ; and that cracks and crannies in the buildings should be filled by painting or other means.

EVANS (A. C.). **Physiological Relationships between Insects and their Host Plants. II. A preliminary Study of the Effects of Aphides on the Chemical Composition of Cabbage and Field Beans.**—*Ann. appl. Biol.* **28** no. 4 pp. 368–371, 2 figs., 5 refs. London, 1941.

The following is the author's summary. Infestation of cabbage by *Brevicoryne brassicae*, L., caused a marked decrease in the amount of carbohydrate synthesised, but smaller decreases in fat, crude protein and other constituents. Infestations of field beans by *Aphis fabae*, Scop., did not have any great effect on the chemical composition of the crop.

MASSEE (A. M.). **Notes on some interesting Insects observed in 1940.**—*Rep. E. Malling Res. Sta.* **28** (1940) pp. 61–65. East Malling, 1941.

Several severe outbreaks of *Rhynchites germanicus*, Hbst., which is not normally a serious pest, occurred on strawberry in Kent in the latter part of April and in May 1940. The eggs are deposited in May singly in the stalks of the leaves or fruit trusses, which are then girdled [*cf. R.A.E.*, A **24** 684] ; young plants are preferred for oviposition, but in one district where an acre of one-year-old plants was completely defoliated, two- and three-year-old plants in adjoining fields were also damaged. Outbreaks can be checked by a prompt application of derris dust, but where infestation is severe, a second application

may be necessary, especially in rainy seasons. The cold winter of 1939–40 considerably reduced the populations of the strawberry aphis [*Capitophorus fragariae*, Theo.] in Kent [*cf.* next abstract] and of the four Aphids that infest blackberry, loganberry and raspberry [*cf.* **28** 581].

Xyleborus (*Anisandrus*) *dispar*, F., caused considerable damage to newly-planted plum trees in several parts of Kent ; in one place it had evidently been introduced in nursery stock, since it was well established in two-year-old trees and had killed some of them. The adult females leave the galleries during April and May, and the infested branches should therefore be removed and burnt by the end of March. The ratio of males to females appears to be about 1 : 6, but the males are rarely seen, though they can be found in the galleries in autumn and winter.

The Capsid, *Plesiocoris rugicollis*, Fall., which must be considered the most important pest of apple in Britain, has not only spread throughout most of the fruit-growing areas of Kent in recent years, but has also become established in small orchards and on isolated apple trees. Co-operative measures are suggested to obtain commercial control throughout the country. After careful pruning to enable spraying to be properly carried out, the trees should be sprayed when the buds are beginning to swell (generally during the last two weeks of March) with an emulsion of petroleum oil at a concentration of 7·5 per cent. The spraying equipment should develop a nozzle pressure of 300–400 lb. per sq. in. and have a good agitator in the tank. If the Capsids are observed when it is too late to use a dormant spray, one containing 10 oz. nicotine and 6 oz. spreader in 100 gals. water should be applied at the pink-bud stage, preferably on a windless warm sunny day ; adhesive bands should first be fixed to the trees to trap any nymphs that fall to the ground and attempt to crawl back.

It has recently been shown that at least 11 leafhoppers breed on apple in Britain, and of these, *Typhlocyba froggatti*, Baker [**29** 284] appears to be of potential economic importance. Two generations of this Jassid have been observed during the year, and the eggs overwinter in the tissues of young shoots and branches. In addition to apple, its food-plants include pear, plum, cherry, quince and hawthorn [*Crataegus*]. *T. quercus*, F., was associated with *T. froggatti* on apple, but was less common ; it normally attacks oak, and hibernates in the adult stage among dead leaves and in the foliage of evergreens. *Eupteryx stellulata*, Burm., is common in many parts of Kent on oak and lime [*Tilia*], and of late years has become more abundant on fruit trees, on which it has apparently not hitherto been recorded in Britain. It is now locally numerous on plum and cherry, but is not yet of economic importance.

On 27th May 1940, adults of *Tomaspis* (*Cercopis*) *sanguinea*, Geoffr., were observed feeding on the foliage of apple and the fruit of pear in a mixed plantation from which damage by them had also been reported during the two previous years, and was so severe to pear that the crops were unmarketable. Their feeding on apple leaves results in the formation on both surfaces of angular green marks that later turn brown and may number as many as 200–300 on a single leaf. On the fruitlets of pear, it causes the production of rough corky patches and blisters and, if severe, causes the fruit to split ; the stalks of pears are also often split, causing them to become scarred and twisted. It is now agreed that this Cercopid is the primary cause of angular leaf-spot of apple [**29** 282], the fungus that is also present being saprophytic on the dead tissue.

An outbreak of *Euacanthus interruptus*, L., occurred in one hop garden in Kent during the year. The nymphs first appeared in May, when they were very abundant and fed on the lower leaves ; later in the year the growing points of the bines were attacked and their growth was stunted. This Jassid has one generation a year. The eggs are deposited chiefly in cracks in the poles in August, and hatch in the following spring. The nymphs and adults feed on the lower surfaces of the leaves, causing them to split, and on the bines, usually near the tips. If infestation is severe, the leaves turn pale yellow, and the bines

may be partly defoliated. Injury to the cones has not been observed. *E. interruptus* is common on weeds and cultivated plants in Britain and was abundant in the hedgerows and headlands bordering several hop gardens, which, however, were not infested. Populations were greatly reduced following two applications of a derris dust in July. *Contarinia humuli*, Tölg, has of recent years increased steadily on hops in Kent, Worcestershire and Hampshire, and has become an important pest in parts of Kent. In one of these, adults were first observed on 23rd July ; the peak of the flight period appears to occur about mid-August.

GREENSLADE (R. M.). **Strawberry Aphis and the Weather in 1940.**—*Rep. E. Malling Res. Sta.* **28** (1940) pp. 65–66, 1 ref. East Malling, 1941.

The unusual scarcity of *Capitophorus fragariae*, Theo., on strawberry in Kent during 1940 appears to have been due to severe weather during the preceding winter. The population index [*R.A.E.*, A **28** 403] on a 4-acre field was 2·79 on 29th September 1939 and the population on the untreated part of this field remained fairly high until early December. Snow fell at the end of December and remained on the ground for over a month, during which the ground temperature reached —5°F. A search for Aphids under the snow on 28th January yielded 39, of which only 2 were alive. A thaw in February was followed by further snow, and the examination on 12th March, two days before yet another fall, revealed the presence of only one Aphid on 500 plants. In June, when populations are normally at a peak, Aphids occurred in small numbers, and on 11th July the population index was 1·01 ; it had, however, increased to 2·60 (about its normal level) by 4th September and 2·82 by 28th October.

On 29th September 1939, 3 acres of the field were treated with vaporised nicotine [see next abstract], and in this part no Aphids were observed until September 1940 and the population index was only 1·64 on 30th October. Among samples of 70 leaves from the treated and 70 from the untreated part of the field, 33 of the former and only 1 of the latter were uninfested. As the very small population left in the untreated part by the severe winter had increased to normal size by September, the Aphids in the treated part are thought to have been almost exterminated by the combined action of the nicotine and the severe weather, those present in October having migrated from the untreated part.

MASSEE (A. M.) & GREENSLADE (R. M.). **Work at East Malling on the Control of the Strawberry Aphis.**—*Rep. E. Malling Res. Sta.* **28** (1940) pp. 92–94, 2 figs., 6 refs. East Malling, 1941.

After reviewing previous unsuccessful work at the Research Station on the control of *Capitophorus fragariae*, Theo., on strawberry, the authors describe and discuss successful field trials with vaporised nicotine carried out there in 1939 and 1941, following satisfactory laboratory tests in 1937. The machine used released the hot nicotine vapour under a dragsheet trailed behind it. The sheet was wide enough to cover seven rows of strawberry plants and 100 ft. long, and maintained the concentration of nicotine vapour for the whole of its length. In 1939, about 3 acres of a 4-acre field were treated, and the percentage control was 99·8. Most of the small population that had built up by October 1940 [*cf.* preceding abstract] was on plants near the untreated plot, from which migration by apterous individuals had evidently taken place, since winged forms were not observed in that year. In July 1941, all the commercial plots at the Research Station were treated successfully, one living Aphid being found in a sample of 400 leaves. Since nicotine vapour is not toxic to predacious insects,

any Aphids that survive it would probably be destroyed by them. The elimination of *C. fragariae* from the Research Station would facilitate the raising of virus-free stock, since no strawberries are grown within a mile of it, and any winged Aphids that might enter the plots during the migration period [*cf. R.A.E.*, A **30** 243] could be destroyed with nicotine vapour as soon as it was over. This would be particularly effective at East Malling, where the migration period lasts only for 7–10 days ; elsewhere it may be as long as 6 weeks, which would allow some breeding to take place before the plants could be fumigated, and thus increase the risk of spread of virus.

GREENSLADE (R. M.). **The Black Currant Leaf Midge** *Dasyneura tetensi* **(Rübs.).** —*Rep. E. Malling Res. Sta.* **28** (1940) pp. 66–71, 3 figs., 9 refs. East Malling, 1941.

Dasyneura tetensi, Rübs., which was first recorded in England in 1917, has in recent years increased its range in Kent [*R.A.E.*, A **28** 99], where it has assumed importance as a pest of black currant in nurseries, and its bionomics and control were accordingly investigated there during 1940. Earlier records that black currant is its only food-plant [**27** 673] were confirmed by observations on a small plot containing 43 species of *Ribes*. Eggs are deposited between the folds of the young leaves at the tips of the growing shoots. The larvae feed on the leaves, which continue to grow but remain folded ; at the time of hatching, when the leaves are growing fast, they may become deformed within a day. As many as 14 larvae were found in a single leaf, but the usual number is 4 or 5. The full-grown larvae enter the soil and pupate in silken cocoons. The autumn and winter are passed as a pupa or possibly as a resting larva. The flight period of the adults lasts 10–14 days ; they are very active in still weather, but shelter at the base of the bushes, on the lower parts of the stem and among dead leaves on the ground when there is wind. Three generations and at least a partial fourth occurred during the year, adults being observed in early May, mid-June, early July and early August. The periods in these four months during which eggs and full-grown larvae were present are shown on a diagram. Fourth-generation larvae were observed only on varieties of black currant that continued to produce young leaves during dry weather in August, and it is therefore concluded that in plantations not containing these varieties some of the third-generation pupae must overwinter. During the year, some cuttings planted 500 yards from the nearest black currants became infested, presumably as a result of migration by the adults.

The fruit crop of established bushes appears not to be affected by the infestation, injury consisting chiefly in malformation of the terminal leaves, although the growing point is often stunted and defoliated, but the growth of nursery stock is inhibited. The leaves open after the larvae have left them, and the injury then superficially resembles that caused by *Lygus pabulinus*, L. Considerable differences were observed in the percentages of shoots damaged on different varieties of black currant. In May, larvae on bushes exposed to wind were confined to the tips of young shoots within a foot from the ground, whereas infested shoots occurred on all parts of bushes protected by windbreaks ; in July and August, after windless weather, infested shoots were present on all parts of bushes in both situations. The degree of infestation was greatest on the soils that promoted the most vigorous growth.

Sprays of nicotine with soap were ineffective against the larvae, but many dead larvae were found on and under bushes that were fumigated on 14th, 15th and 21st May by covering them with a sheet and vaporising nicotine from a shallow pan by means of a lamp. A dust containing 3 per cent. nicotine applied against the adults at the rate of 56 lb. per acre on 7th August was very effective, but would not afford complete control at any time at which pupae are in the soil. It was directed chiefly into the base of the bushes, where most of the midges rest.

Shaw (H.) & Steer (W.). **Dinitrocresol and other dual purpose Winter Washes.** —*Rep. E. Malling Res. Sta.* **28** (1940) pp. 72–75, 12 refs. East Malling, 1941.

Since combined sprays of tar-distillate and petroleum-oil emulsions for the control of the overwintering eggs of pests on fruit trees in Great Britain have to be used at high concentrations and are apt to damage the buds, attempts have been made to evolve a more satisfactory spray by including in a petroleum oil emulsion some substance toxic to the eggs of Aphids and *Psylla* (*Psyllia*) *mali*, Schm., which are normally controlled by the tar distillate. Preliminary laboratory tests in 1937 showed that n-dodecyl thiocyanate (lauryl thiocyanate) and Lethane 410, which contains 75 per cent. β-butoxy-β′-thiocyanodiethyl ether (butyl carbitol thiocyanate), were toxic to eggs of *Aphis pomi*, DeG. ; and in 1938, 0·05 per cent. dinitro-ortho-cresol in 5 per cent. of a petroleum oil (conforming to Grade E specification, as given in a paper already noticed [*R.A.E.*, A **23** 497]) and in 1 per cent. of a special petroleum oil of high solvent power for it, emulsified with sulphite lye, gave complete mortality of the eggs, the oils alone having only slight toxicity. In 1939, mortality was complete when the percentage of Grade E oil was reduced to 3, and that of the dinitro-o-cresol to 0·025, but some eggs hatched when the latter was 0·01. Complete mortality was also given by 0·1 per cent. Lethane 410 in the 3 per cent. oil emulsion, but not by 0·2 per cent. n-dodecyl thiocyanate. In field trials in 1940, satisfactory control of the eggs of *Psylla mali* and *Anuraphis roseus*, Baker, on apple was given by a sulphite-lye emulsion of 5 per cent. Grade E petroleum oil containing 0·05 per cent. dinitro-o-cresol and of *A. roseus* but not of *P. mali* when the percentage of dinitro-o-cresol was reduced to 0·025, but when 0·1 per cent. Lethane 410 was substituted for dinitro-o-cresol, the control was only moderate and compared unfavourably with that given by a soap-emulsified tar wash containing 2 per cent. neutral oil.

Tests were also made in the laboratory on eggs of *Operophtera brumata*, L., and *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.), which are normally controlled by petroleum oil. None of the three insecticides or sodium dinitrocresylate was sufficiently toxic to *Operophtera* to contribute materially to the control given by winter petroleum oil. Dinitro-o-cresol was more toxic to the eggs of *P. pilosus* than Lethane 410 when both were used at a concentration of 0·1 per cent., but the amount of oil likely to be used with such a concentration is itself sufficiently toxic. In a small scale trial in 1939, the addition of 0·05 per cent. dinitro-o-cresol did not detract from and may have increased control of *Plesiocoris rugicollis*, Fall., by a 3 per cent. oil emulsion applied on 31st March, but the use of oil alone is recommended against this Capsid. Dinitro-o-cresol must be applied not later than mid-March to avoid scorching, at which period experiments have shown that an oil concentration of not less than 6 per cent. is required to control *P. rugicollis* [see next abstract]. In a discussion of the cost of application of various dormant sprays, dinitro-o-cresol is shown to be the cheapest material to use with petroleum oil ; where spraying is unavoidably delayed or market crops are planted between the trees, thiocyanate sprays may be of value.

Steer (W.) & Moore (M. H.). **Spray Damage and Apple Capsid Control by Winter Petroleum.**—*Rep. E. Malling Res. Sta.* **28** (1940) pp. 76–81, 12 refs. East Malling, 1941.

The effect of the date of application of petroleum-oil emulsions on damage to the buds of apple and plum and on the control of *Plesiocoris rugicollis*, Fall., on apple was tested in Kent in 1940. In order to determine the influence of heavy deposits of oil (which are likely to result from spraying in windy weather), some trees were allowed to dry after spraying and were then sprayed again on

the same day. Grade E petroleum oil, emulsified with oleic acid and sodium hydroxide at 1 quart and 6 oz., respectively, per 100 gals. emulsion, was employed at a concentration of 5 per cent. on plum and 6 per cent. on apple.

On plum, the dates of spraying compared were 21st and 29th February, 20th March and 2nd April, and the trees were inspected on 19th April. Those that had been sprayed twice exhibited more injury than those that had been sprayed once, or were injured where the others were not. Double spraying caused least damage when it was performed on 20th March ; trees sprayed once on 29th February were only slightly damaged. Injury to trees that were sprayed in February and March comprised dead flower buds, dwarfed and short-stalked flowers, blackened bark and, in some cases, retarded or dead leaf-buds, whereas on those sprayed on 2nd April, the petals were browned and the leaf-tips scorched. Injury appeared to be rather more severe on trees on common plum than on Myrobolan rootstocks. Observations on the numbers of fruits produced per tree in August and September supported these conclusions in the case of trees on common plum stock. The figures showed that two applications were more injurious than one and that 20th March was the safest date. Differences between the other dates could not be determined. The differences in weight of crop were less marked, as the fewer fruits on the damaged trees were larger ; they confirmed the effect of the rate of application, but not that of the date. With Myrobolan rootstock, the yield was significantly lower on twice-sprayed trees, but there was no marked difference that could be attributed to the date of spraying, and no significant effect on the size of the fruits.

Similar but less pronounced results were obtained on apples sprayed in February or March or on 8th April. Damage, which was less severe than in the case of plum, consisted in the retardation of buds, except on trees sprayed on 8th April (after bud-burst), when the foliage was scorched. Injury was most severe on trees sprayed twice on 25th February. Two instances are cited in which local damage resulted when sprayed trees that dried during intervals for refilling the spray tank received drift deposit when spraying was continued, and data in the literature indicating a correlation between spray injury and drift deposit are reviewed.

Work on the best date for the application of various petroleum and tar-oil sprays against *P. rugicollis* is reviewed from the literature. When the leaves of apple trees treated with sprays containing 5, 4 or 3 per cent. petroleum oil emulsified with oleic acid and sodium hydroxide on 29th February, 20th March and 2nd April 1940 were examined for Capsid injury on 22nd April, those sprayed on the latest date showed the fewest marks, but the difference between them and leaves sprayed in March was not significant. The oil was more effective at 5 per cent. than at either of the other concentrations, but adequate control was given only by 5 per cent. oil applied on 20th March and by 5 or 4 per cent. on 2nd April. Some scorching of the leaf-tips and bronzing of the rosette leaves followed the application in April, but was of no ultimate importance.

As a result of these investigations, the authors recommend that spraying should be begun in mid-February, to avoid the risk of spray drift caused by March winds and of scorch resulting from the direct action of the spray on young leaves and from its interaction with mixtures containing lime-sulphur and arsenicals used on apple in April to control scab. They point out that, although oil at a concentration of only 5 per cent. has to be applied in late March or early April to give good control of the Capsid, in practice a concentration of 6 per cent. is invariably used, and investigations have shown it to be effective, when thoroughly applied, as early as mid-February [*R.A.E.*, A **21** 372]. Factors other than spray drift, such as a high concentration of oil, may influence the amount of deposit, but it is doubtful whether they are of importance in themselves.

Massee (A. M.) & Greenslade (R. M.). **The Control of the Hop Red Spider.**—*Rep. E. Malling Res. Sta.* **28** (1940) p. 94. East Malling, 1941.

As a result of recent experiments on the control of the hop red spider [*Tetranychus telarius*, L.] on hops at East Malling and in commercial hop gardens, a spray of lime-sulphur in water (1 : 99) is recommended to destroy the adults before the main oviposition period begins and before they spin webs on the lower surfaces of the leaves. The mixture should be applied as a fine spray by means of a power sprayer or "hop-washer" in May or early June after the lower leaves have been removed (a procedure that is recommended where *T. telarius* is present), but before the bines reach the breast wire. One application is generally sufficient, but where the mite persists each year, a second may be necessary after ten days. No injurious effects were noted; if it is necessary to delay spraying until July, which is undesirable, it should not be performed within ten days of the routine application of Bordeaux mixture against downy mildew.

[Ponomarenko (D. A.).] **Пономаренко (Д. А.).** *Phytonomus* **as a Pest of Seed-Alfalfa in the South-east of the USSR and Methods of its Control.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 22–36, 2 figs., 7 refs. Leningrad, 1941.

A detailed account is given of observations in 1937–39 on the bionomics of *Hypera* (*Phytonomus*) *transsylvanica*, Petri, on lucerne in the Republic of the Volga Germans [*cf. R.A.E.*, A **27** 108]. The overwintered adults appear early in spring when the temperature at the soil surface is 9–10°C. [48·2–50°F.] and become very active when it reaches 11–14°C. [51·8–57·2°F.]. Sharp fluctuations in temperature combined with high soil humidity are detrimental to the weevils in spring and sometimes cause a mortality of 50 per cent. They continue to feed from the time they emerge from hibernation until their natural death, which takes place between June and August. At 28–30°C. [82·4–86°F.], they become inactive and shelter in the soil close to the humid layer. Excessive humidity of the soil, caused by watering or prolonged rain, combined with a temperature of 13–15°C. [55·4–59°F.], reduces their activity and fertility. The overwintered females are sexually immature, and the rapidity of maturation varies with the temperature. Oviposition usually begins when the first green shoots appear on lucerne. The eggs are laid in batches of up to 40 in cavities made by the females, chiefly in the stems and sometimes in the buds, and the period of mass oviposition lasts from the end of April to the beginning of June. Occasionally, in hot and dry weather, some of the adults enter a diapause in the soil and oviposit again in September. The average and maximum numbers of eggs laid by females in captivity were 420 and 1,039 in 1937 and 321 and 658 in 1938. The egg stage lasted 8 days at a mean of 23·3°C. [73·94°F.], and the larval stage 21–25 days at 18·3–26·3°C. [64·94–70·34°F.]. Lack of humidity causes high mortality among the larvae and young adults. The pupal stage lasted 3–8 days, depending on temperature.

The adults do not cause any serious damage, but the larvae, by feeding on the stems, side shoots, leaves, buds and flowers, considerably reduce the yield of seeds and hay. In severely infested fields, the plants become stunted, the stems, shoots and stipules thicken, and tufts of small leaves are produced by the new buds that develop near the injured ones. Infestation is favoured by the continued growing of lucerne in one place and by growing it for seed, since when the crop is mown for hay when it begins to flower, about 90 per cent. of the larvae and pupae are removed from the field with it. If lucerne is grown for seed after being mown for hay at this stage, infestation in the seed crop is considerably reduced.

For the planning of control measures, the spring infestation should be ascertained during the flowering of the first crop in fields planted not less than a year

previously, by counting the numbers of larvae collected in 100 sweeps along each of the diagonals of the field. Also, samples of soil taken to a depth of 4–5 ins. along one diagonal of the field in autumn (if the soil is fairly damp) and early spring should be examined for hibernating weevils ; an average density of 4 weevils per square yard justifies active control. In irrigated fields, 50–100 stems of the first crop should be taken along each of the diagonals, before the appearance of the green inflorescences, and the buds dissected and examined ; if 50 per cent. or more of the top buds are infested, the crop should be cut for hay before being grown for seed.

In experiments on control, high mortalities of the overwintered weevils were obtained by dusting the sprouting lucerne twice at intervals of 3–4 days (in the second half of April or the beginning of May) with calcium arsenite (62·5 per cent. As_2O_3), calcium arsenate (38·3 per cent. As_2O_5) and sodium fluosilicate at the rates of 9, 13½ and 18 lb. per acre, respectively [*cf. loc. cit.*]. Calcium arsenite caused slight scorching if dusting was followed by rain or dew. The effectiveness of the treatment progressively decreased as the lucerne grew. Dusting is of particular value on lucerne of the fourth year. Cultural control measures are discussed [*cf. loc. cit.*].

[Strel'tzov (I.).] **Стрельцов (И.). The Life History of the Plant Bug** *Adelphocoris lineolatus* **Goeze on Alfalfa on the Grassland in the Ukraine.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 37–39. Leningrad, 1941.

In view of the serious losses caused by the Capsid, *Adelphocoris lineolatus*, Goeze, to lucerne seed-crops in the steppe zone of the Ukraine, observations on its bionomics were carried out, chiefly in the Province of Dnepropetrovsk, in 1938–39. It has two generations a year and hibernates in the egg stage in the stubble [*cf. R.A.E.*, A **27** 475]. The eggs laid by adults of the overwintered generation were found to be much more numerous than those laid by summer generation adults, since the latter emerge in the second half of July at about the time when the lucerne is cut, and thus have only a short time for oviposition. The period available was 8 days in 1938, while in 1939 the lucerne was cut before the adults emerged. The severity of the infestation depends, therefore, on the length of the period between adult emergence and the mowing of the crop. In the winter of 1939–40, considerably more winter eggs occurred in the stubble of first-year lucerne than in that of old lucerne ; the old lucerne had matured when the first-year lucerne began to flower, and the adults of the overwintered generation migrated to the latter and gave rise to a summer generation that laid an appreciable number of winter eggs on it. The summer eggs are laid in the central stems and side shoots, and the egg batches are more or less evenly distributed along the stems. The winter eggs, however, are laid in the lower part of the stem at a height of about 2 ins. As the lucerne is cut at a height of about 3 ins. above the ground, some 85 per cent. of the winter eggs remain in the stubble. Observations showed that the nymphs migrate only within the field in which they hatch.

[Yarmolenko (I. M.) & Medvedev (S. I.).] **Ярмоленко (И. М.) и Медведев (С. И.). Methods of Destruction of the Gray Beet Bug Larvae** *Poeciloscytus cognatus* **Fieb. on the disused Lands in the Altaï Region.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 40–42. Leningrad, 1941.

The Capsid, *Poeciloscytus cognatus*, Fieb., is a major pest of beet in the region of the Altaï mountains (southern Siberia). The winter eggs are laid on weeds on waste land, and the nymphs develop on them in spring, the beet being infested by the resulting adults. The destruction of the eggs and nymphs on the weeds seems to be the most promising method of control, and field experiments in this connection were carried out in May and June 1939. The effectiveness of the treatments was estimated by counting the nymphs on the weeds before and

1, 3 and 5 days after them. The best results (98–99 per cent. mortality) were obtained by ploughing in the weeds to a depth of 9–10 ins., whether this was followed by harrowing or not. Grass should be grown on the ploughed land, to prevent the return of the weeds. Burning the weeds (with the addition of straw when there was little natural dry cover on the soil) killed 89–93 per cent. of the nymphs, and an emulsion of 10 per cent. spindle oil and 0·5 per cent. soap, which was the best of several sprays tested, killed about 90 per cent. This spray is recommended if ploughing in or burning is not practicable, but it should not be applied to cultivated plants, since it caused scorching.

[Berezina (V. M.).] **Березина (В. М.). Effect of hydrothermic Soil Conditions on the vertical Migration of the Cockchafer Larvae** *Melolontha hippocastani*. [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 43–56, 8 graphs, 27 refs. Leningrad, 1941.

A detailed account is given of investigations on the effect of temperature and humidity on the vertical migration of the larvae of *Melolontha hippocastani*, F., in the soil. Those in 1937 were made in a pine forest in the Province of Voronezh [*cf. R.A.E.*, A **26** 430], cubes of soil of 1 cu. m. [35 cu. ft.] in volume being taken at intervals of 5–6 days from 9 points representing different microclimates and types of soil. The distribution of the larvae and the temperature and humidity of the soil were recorded. An upward movement of the overwintered larvae occurred in spring and was not directly affected by soil temperature or, in the upper layers, by humidity, but in the deeper layers, close to the water table, it was considerably accelerated by the prevailing high humidity. In June–July, the numbers of larvae in the upper layers varied inversely with the temperature and directly with the humidity, those in warm dry soil moving downwards, but from the end of July onwards a change began. In places exposed to the sun, the larvae returned to the upper 4 ins., though the soil was dry and its temperature still 19–20°C. [66·2–68°F.], and remained there until September, when they migrated to hibernation depth, but in the shaded plots they moved downwards and entered hibernation at the end of July. Other factors affecting vertical migration were the presence or absence of food, and the compactness and aeration of the soil. Thus, ascent was retarded in compact soil, and under conditions of insufficient aeration in humid sandy black soil in August the larvae tended to concentrate in the hot upper layers, whereas those at the same temperature in dry sand in forest clearings descended deeper.

In 1938, experiments were carried out under controlled conditions. In one series, two-year-old larvae were kept at 17–20°C. [62·6–68°F.] in long narrow boxes filled with sand of graduated humidity, one being horizontal and two others standing upright so that the wetter sand was at the top in one and at the bottom in the other. Examination after three weeks showed that the larvae in all boxes moved from the dry sand into the damper layers, the greatest number occurring in sand with a humidity of 6–7 per cent. In experiments in which the humidity of the sand was 6 per cent. but its temperature was graduated from 16 to 24°C. [60·8–75·2°F.], the larvae concentrated at the lowest temperature. Larvae kept for 66 days without soil at various relative humidities fed during the entire period only at 100 per cent. humidity ; they fed for about a fortnight at 76 per cent., and not at all at lower humidities. Their weight increased at 100 per cent. but decreased at all other humidities, and the percentage mortality rose as the humidity decreased. The development of larvae in sand was most intense when the humidity of the latter was 6–7 per cent. ; it was retarded at other humidities, but less at higher than at lower ones. At low humidities the larvae became flabby and covered with sand, which blocked the stigmata and sometimes the tracheae and thus interfered

with respiration. These larvae died sooner than individuals kept without soil, which continued to live for some time after losing half their initial weight owing to insufficient humidity.

In experiments on the effect of heat, larvae kept without sand at 100 per cent. relative humidity and temperatures that ranged from 8 to 41°C. [46·4–105·8°F.] fed only at 8–25°C. [77°F.]. Maximum weight was reached at 14–16°C. [57·2–60·8°F.], development was retarded at 8 and 21–25°C. [69·8–77°F.] and no larvae survived at temperatures higher than 28°C. [82·4°F.]. Analysis of the larvae showed that the maximum amount of water, dry matter and in some instances fat accumulated at 14°C. Any decrease in humidity reduced the content of water and dry matter, the reduction in the latter being proportionate to the amount of water in the organism. The amount of fat was not affected, however, by decreased humidity or by temperatures up to 21°C. [69·8°F.]. Of the larvae reared at temperatures and humidities above the optimum, 22 per cent. entered a diapause, which usually lasted 6–24 days and was sometimes interrupted and resumed 2 or 3 times. The weight of such larvae decreased slightly, but the percentage mortality among them did not exceed that among non-diapausing individuals.

[Gusev (V. I.).] **Гусев (В. И.). Insect Pests of Walnut on the Black-Sea Coast of the Caucasus.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 57–61, 2 refs. Leningrad, 1941.

Records are given from the literature and personal observation of insects and mites that attack walnut on the Black Sea coast of the Caucasus, with brief notes on their bionomics and in some cases control. Of those that injure the leaves, the most important are the gall mites, *Eriophyes tristriatus*, Nal., and *E. erineus*, Nal., which retard the development of nursery seedlings, and the larvae of *Gracilaria roscipenella*, Hb., which mine and skeletonise the leaves and pupate in cocoons in the rolled leaves, giving rise to adults in the second half of July. The chief pests of the branches and trunks are *Morimus asper*, Sulz., and *Leiopus nebulosus*, L., though the former occurs mostly in old stems damaged by fire, and the latter attacks dying stems. The adults of these Lamiids are on the wing in June and July and feed on the bark before ovipositing ; the eggs are laid in the bark, and the young larvae construct long galleries in the wood. Of the bark-beetles, *Trypodendron* (*Xyloterus*) *domesticum*, L., *Xyleborus xylographus*, Say (*Xyleborinus saxeseni*, Ratz.) and *Xyleborus* (*Anisandrus*) *dispar*, F., are the commonest. *X. pfeili*, Ratz., which has been recorded only from alder and aspen, chiefly from trees growing in marshy or flooded places, was observed by the author in walnut.

The nuts are severely injured by *Cydia* (*Carpocapsa*) *pomonella putaminana*, Stgr., the larvae and pupae of which are briefly described. In the district of Sochi, there are two generations a year. The adults are present in May and deposit their eggs, usually singly, on the surface of the young fruits and sometimes on the leaves. The larvae hatch in a week and enter the fruits near the base. They feed on the mesocarp, and most of them also bore into the nuts and attack the cotyledons, which are sometimes completely destroyed. First-generation larvae often migrate from one fruit to another and may thus damage up to 10. The full-fed larvae leave the fruits and pupate in cocoons, usually on the lower part of the trunk in cracks or under the bark scales, and occasionally on the fruits or among fallen twigs. The pupal stage lasts 9–10 days, and the adults, which emerge at the end of July or the beginning of August, oviposit on the fruits. Infested fruits usually drop sooner than healthy ones. The second-generation larvae leave the fallen fruits in autumn and spin cocoons in cracks in the bark of the trees, preferably on the lower part, in which they hibernate. Pupation occurs in spring. Counts showed that 55–71·8 per cent. of the fruits were infested, and the damage involved the contents of the nuts in 82 per cent. of the infested fruits.

Recommendations for control comprise the destruction of infested fallen fruits and the application of trap bands of straw or coarse paper at the beginning of July and again at the end of August. The bands should be fixed round the tree trunks at a height of about 5 ft. Their efficiency is improved by applying an adhesive to the outer surface, or to the inner lower edge of the paper, and all uneven places on the bark below the band should be smoothed or filled with clay.

[Ivanova-Aleksandrovskaya (Z. V.).] **Иванова-Александровская (З. В.). The Use of Vivianite in Grain Cellars.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 62–66, 4 refs. Leningrad, 1941.

The floors of granaries on Russian farms are usually raised above the ground on stone or wooden supports and spilt grain and flour accumulate in the space thus formed and constitute an important source of infestation by pests for the grain above. Since it is difficult to fumigate such spaces, and treatment with liquids leaves the soil wet for a long time, the possibility of using vivianite [*cf. R.A.E.*, A **28** 126] was studied. As a preliminary test, flour severely infested with mites was placed on soil in boxes, and vivianite was either mixed with it or scattered on it or on the soil. The temperature and humidity of the air varied from 17 to 25°C. [62·6–77°F.], and from 50 to 67 per cent., and the humidity of the soil from 2·6 to 4·9 per cent. The results were estimated by counting the dead mites at intervals of 5 days for a month. Complete mortality was obtained in 30 days when the vivianite was used at the rate of 30 oz. per sq. yd. and was mixed with the infested flour. Scattering it was ineffective if the layer of flour was 5–10 mm. thick, but gave complete mortality in 25 days if the layer was very thin, which indicates that direct contact with the mites is essential. Further experiments showed that the toxicity of vivianite is reduced at temperatures below 12°C. [53·6°F.] and relative humidities above 80 per cent., and that mites and weevils cannot migrate from infested to uninfested grain through a half-inch layer of vivianite. In tests of its adhesiveness, it adhered well to vertical walls of wood, brick, iron, or tarred roofing paper.

The results obtained in the laboratory were confirmed in experiments under farm conditions in which vivianite was scattered at the rate of 7½ or 15 oz. per sq. yd. over spilt flour severely infested with mites under the floor of a granary. The results were estimated by examining samples of the flour at intervals for a month, during which period the temperature varied from 20 to 28°C. [68–82·4°F.] and the relative humidity from 50 to 58 per cent. Very few mites survived where the layer of flour was thin, but many did so when it was thick, even though the dust was applied at the higher rate. In further experiments on farms in hot dry weather complete mortality of mites and *Tenebrio molitor*, L., in flour under the floor of granaries was obtained in 5 days by scattering vivianite over the flour at the rate of 30 oz. per sq. yd. and applying it through a sieve to the props and beams. This dosage is, therefore, recommended for practical use.

[Khara-Murza (D. A.).] **Хара-Мурза (Д. А.). The biological Control of Pentatomid Bugs by using Poultry.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 76–78, 5 refs. Leningrad, 1941.

An account is given of experiments in 1938–40 in the Province of Stalin, south-eastern Ukraine, in which effective control of Pentatomids of the genera *Eurygaster* and *Aelia* in their hibernation quarters was obtained by allowing large numbers of hens to feed in forests where the bugs occurred. The experiments were on an increasing scale each year, until in the spring of 1940, 14,500 hens were used over about 1,900 acres. It is estimated that in one section of about 570 acres in which the density of the bugs was 52 per sq. yd., 97·7 per cent. were destroyed by just under 6,000 hens in 23 days. It is concluded from

the work as a whole that the number of hens required varies with the density of the bugs ; where the average density of the bugs per sq. yd. is 84, adequate control is obtained with about 490 hens per acre in one day.

[Serbinov (V. I.) & Korsakova (M. V.).] **Сербинов (В. И.) и Корсакова (М. В.). Experiments on the Use of *Bacterium galleriae* for the Control of Apricot Insects.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 79–84, 2 refs. Leningrad, 1941.

An account is given of laboratory and field experiments on the utilisation of *Bacterium galleriae* against the larvae of the Noctuid, *Cosmia* (*Calymnia*) *subtilis*, Stgr., and the Geometrid, *Apocheima cinerarius*, Ersch., on apricots in northern Tadzhikistan. The three strains of the bacterium tested were cultured on a broth of dry chopped lucerne, with or without the addition of agar-agar, and sprays were prepared by diluting the cultures with water (after washing if agar was used) or by making an aqueous suspension of the dried spores on potato flour. The sprays were tested on twigs in the laboratory and on twigs and trees in the field, and one strain of the bacterium appeared to be considerably more pathogenic to *Cosmia* than the others. A mixture of all three strains was the most effective against *Apocheima*. The suspension of the dried spores was the most pathogenic spray, and the most rapid in action, and in the field it reduced the percentage of infested fruits by over 75 per cent. Since the orchards are sometimes bordered with mulberry trees, the leaves of which are used for breeding silkworms [*Bombyx mori*, L.], the effect of the sprays on silkworms was tested. Leaves sprayed 5 days previously were pathogenic to them, and those sprayed 15 days previously caused a reduction in the quality of the cocoons. The sprays should therefore not be applied to apricot trees if there is danger of their reaching mulberries.

[Ostrovskiĭ (N. I.).] **Островский (Н. И.). Contribution to the Diagnostics of the Death of Insect Larvae.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 85–87, 3 refs. Leningrad, 1941.

The author recapitulates his investigations on the use of dinitrobenzene for distinguishing between living and dead larvae of the Eurytomid, *Systole coriandri*, Nikol'skaya, following fumigation [*cf. R.A.E.*, A **30** 296], and states that the method is not applicable to those fumigated with alcohol or naphthalene vapour, since they turned red whether or not they had been killed by the fumigation. The method was successfully used to distinguish living larvae of *Mayetiola destructor*, Say, from those that had died during hibernation.

[Mirimanyan (V. A.).] **Мириманян (В. А.). Effect of the Oil Emulsions on the Physiology of *Citrus* Plants.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 88–100, 4 graphs, 13 refs. Leningrad, 1941.

Mineral-oil emulsions have proved very effective for the control of *Chrysomphalus dictyospermi*, Morg., on *Citrus* in the Caucasus, but sometimes injure the trees, and investigations were therefore carried out with the ultimate view of ascertaining the best dates for spraying. In 1936, a 2 per cent. emulsion of transformer oil was applied to mandarin orange trees in summer, and in 1937 a 1 per cent. emulsion of machine oil was applied to lemon trees in early spring and early autumn. The physical and chemical properties of the oils are given.

The following is based on the author's conclusions. The summer application reduced the intensity of photosynthesis and respiration for over a month, and reduced transpiration for a few days, but had no effect on the concentration and osmotic pressure of the leaf sap. The spring application reduced the intensity of photosynthesis for about five months, and particularly for the first

two, and reduced the intensity of respiration for two months, and then increased it for three months to an abnormal degree. Following the autumn spray, photosynthesis was reduced at first, but became normal after about two months. Scorching became apparent in the course of the winter.

It was observed that the stomata of sprayed leaves were wider open than those of untreated ones, and the carbohydrate content of the leaves decreased about a month after spraying. An analysis of the activity of the ferments in the leaves showed that peroxidase activity was considerably reduced, but not catalase activity. The amount of chlorophyll in the leaves was increased, and the growth of the vegetative organs was retarded by one month in spring and by 10 days in summer.

RAU (S. Ananda). **Report of the Entomologist 1939–40.**—*Rep. Tea sci. Dep. U.P.A.S.I. 1939-40* pp. 12–20. Madras [1940]. [Recd. 1942.]

Observations on *Helopeltis* on tea in south Travancore [*cf. R.A.E.*, A **28** 202, 203] were continued during 1939–40. Tea bushes were frequently noted with branches showing ridges and furrows along their longitudinal axis. The tissues beneath these markings were dead and discoloured. This condition is presumably due to the original damage caused by *Helopeltis* to the shoots at the tipping stage, when infested shoots may not be killed outright, but grow into woody branches. The punctured spots would persist as dead areas and sink inwards with the growth of wood all round, producing the furrowed appearance. Such branches may remain weak and unproductive. An isolated case of attack by the shot-hole borer, *Xyleborus fornicatus*, Eichh., was observed on an estate in south Travancore [*cf.* **28** 203] ; the insect was identified as the typical subspecies, and not subsp. *fornicatior*, Eggers, which injures tea in Ceylon [**29** 381], but it was thought that if it bred continuously for many generations on tea in India, it might assume the form of the latter [see next abstract]. *Orthacris incongruens*, Carl, was again reported on tea in the Nilgiris, and another species of *Orthacris* caused considerable damage to tea and dadap [*Erythrina*] in the Tinnevelly district, and also attacked *Citrus*, coffee, and *Grevillea*. The attack was mainly seasonal ; the eggs hatch in January, and injury is most severe from February to May. *Saissetia coffeae*, Wlk., which caused widespread damage, and *Aspidiotus rapax*, Comst. (*camelliae*, auct.) were common on tea in the Nilgiris, but as only occasional bushes were attacked by the latter, infested branches should be pruned and burnt on the spot. *S.* (*Lecanium*) *formicarii*, Green [*cf.* **28** 203] attacked tea in the Anamallais and south Travancore, and larvae of *Cydia* (*Laspeyresia*) *leucostoma*, Meyr., in High Range and the Nilgiris. *Adrama austeni*, Hendel, infested tea seed in germination beds at Wynaad. Attempts to breed this Trypetid in the laboratory were unsuccessful, but it is considered unlikely that the flies would oviposit in healthy seeds.

Cardamon was attacked by *Dichocrocis punctiferalis*, Gn., and *Chionaspis* sp. Larvae of the former bore in the stems and pupate in the burrow, the pupal stage lasting 7–10 days. Other food-plants of this Pyralid are castor, turmeric and ginger. The only measure of control available is the destruction of infested shoots. *Chionaspis* was found infesting the peduncles and was apparently controlled by a spray of fish-oil resin soap.

RAU (S. Ananda). **Report of the Entomologist 1940–41.**—*Rep. Tea sci. Dep. U.P.A.S.I. 1940–41* pp. 41–50. Madras, 1941.

Investigations on *Helopeltis* on tea in south Travancore in 1940–41 showed that there is hardly any relation between the incidence of the bugs and the height of pruning and tipping, but the crop records showed some difference in the amount of damage and the rapidity of recovery from it. Bushes pruned at 24 ins. yielded more than those pruned at 18 or 30 ins. A direct connection has been observed between lack of soil aeration and infestation by *Helopeltis*.

Water-logged soil is said to interfere with the free flow of sap in the bushes and to render them liable to severe attacks by the bug. Satisfactory results have been obtained by draining the subsoil water through short saps dug deep into the hill-sides, which are more effective than long shallow side drains, and by deepening the swamp drains twice a year. Monthly returns from various districts indicated that serious damage by *Helopeltis* was limited to October–December, and that the bug appeared late in all districts. Even where it appeared in June as usual, it did not increase to any extent until September; the maximum damage occurred in December, and, owing to favourable weather, the bug persisted until February or even March.

No case of attack on tea by the shot-hole borer [*Xyleborus fornicatus*, Eichh.] was reported during the year, but an examination of beetles collected over several years on estates near Vandiperiyar [*cf. R.A.E.*, A **26** 148] showed that most of them had characters that were a mixture of those of the subspecies *fornicatus* and *fornicatior*, Egg. [*cf.* preceding abstract]. Features typical of either subspecies alone were possessed by relatively few examples. Thus, even after several years breeding on tea, the insect has not produced a race that is exclusively *fornicatior*. Mites on tea comprised *Eriophyes carinatus*, Green, which was abundant owing to the extremely dry weather, *Tenuipalpus obovatus*, Donn., and *Paratetranychus* (*Tetranychus*) *bioculatus*, W.-M.; all three occasionally occurred on the same bush. *Zeuzera coffeae*, Nietn., caused considerable damage to tea in the Nilgiris and to nursery plants in south Travancore. Young plants under shade baskets were severely damaged by cutworms. *Chalioides* (*Psyche*) *vitrea*, Hmps., was reported from south Travancore, the larvae being abundant on tea under the shade of *Albizzia*, from which the infestation presumably originated.

Pests of shade trees included a Lamiid tentatively identified as *Sthenias grisator*, F. [*cf.* **26** 149], which was prevalent on dadap [*Erythrina*] from October to January. The adults live for several months, during which they may destroy a large number of branches by girdling; eggs are deposited in such branches and each branch may give rise to as many as a dozen beetles. Emergence occurs from February to April with a peak in March. Oviposition has also been observed in October, and it seems probable that some adults of a second generation emerge in the rainy months. Larvae of the Lycaenid, *Cosmolyce* (*Polyommatus*) *boetica*, L., damaged pods of *Crotalaria*; if the plant is grown for green manure, lopping before it begins to flower would control the pest, which oviposits in the flower buds, and prevent the infestation from spreading.

RAU (S. Ananda). *Helopeltis*. **A Summary of Information collected through Replies to the Questionnaire with Comments thereon.**—*Pap. Tea sci. Sect. U.P.A.S.I.* no. 2 pp. 1–8. Coonoor, 1940. [Recd. 1942.]

Factors affecting the occurrence and control of *Helopeltis* on tea in southern India are discussed from replies received to a questionnaire issued to planters in 1940. Annual crop losses due to infestation amount to 3–40 per cent. Although the intensity of the attack varies on different estates in the same district, south Travancore generally suffers the greatest damage. The position has improved in many districts of recent years, but infestation is extending and has become increasingly severe in Mundakayam and the Rani Valley. *Helopeltis* appears to be present on tea throughout the year, but its seasonal prevalence is influenced by weather conditions, since it is intolerant of drought. It is favoured by wet conditions, and early rains or a prolongation of the north-east monsoon extend the season of injury. On many estates, infestation apparently spreads from the same areas each year, and if it could be controlled in these foci from the beginning of the season of injury, a general improvement should be observed over the whole estate. Direct methods of control, have, however, resulted in little or no success, and increased attention is now being

paid to indirect methods that assist the bushes to withstand attack. These include light pruning and plucking and cultural measures. It is most important to select a time for pruning such that tipping during the *Helopeltis* season is avoided, as a serious outbreak may otherwise result. There was little indication that shade had any direct bearing on the pest, but it was generally agreed that swamps encourage severe attacks.

MANNING (J. D.). **Damage to Red Gum Seedlings by Termites.**—*Pap. Tea sci. Sect. U.P.A.S.I.* no. 2 pp. 16–18. Coonoor, 1940. [Recd. 1942.]

In view of reports from a number of estates in South India of damage to the roots of seedlings of red gum [*Eucalyptus rostrata*] planted in clearings, investigations were made on a 20-acre clearing in the Nilgiri-Wynaad at an altitude of 2,500 ft. The seedlings had been raised in baskets in a nursery, and the baskets were placed in pits in the clearing in May–June. After a few weeks, the plants wilted, and examination showed that the main roots had been attacked just below the surface of the soil by termites ; these were identified as *Termes feae*, Wasm., which is primarily a wood tunneller and commonly infests buildings.

Suggested methods of control include treatment of the baskets with a poison prior to use, and watering the pits with nicotine water (prepared by steeping tobacco leaves in water), which is repellent to the termites. Where damage is severe, baits of wood chips poisoned with Paris green (100 parts wood to 1 part Paris green) or soaked in a 10 per cent. solution of sodium arsenite can be used.

RODRIGO (E.). **Administration Report of the Acting Director of Agriculture for 1940.**—18 pp. Colombo, 1941.

A section of this Report (p. D5) deals with work on insect pests of crops in Ceylon and their control in 1940. The rearing and liberation of *Trichospilus pupivora*, Ferrière, the pupal parasite of *Nephantis serinopa*, Meyr., on coconut [*R.A.E.*, A **28** 563 ; **29** 594, 620], was continued on a small scale ; this Tineid is now almost completely controlled by natural enemies. Examinations of coffee berries infested by *Stephanoderes hampei*, Ferr., in areas in which *Prorops nasuta*, Wtstn., had previously been liberated [**28** 563] indicated that this Bethylid is not yet firmly established. The chief food-plant of the larvae of the fruit-piercing moth, *Othreis* sp., was found to be *Anamirta paniculata*. Light-traps were of no value against *Scotinophara lurida*, Burm., on rice, but flooding and oiling the rice-fields was effective ; small stocks of a fairly efficient unidentified Braconid that parasitises the eggs were bred in the laboratory and liberations were made in the infested area. Three natural enemies of *Dichocrocis punctiferalis*, Gn., which attacks turmeric, were recorded ; they are the Braconid, *Phanerotoma hendecasiella*, Cam., the Ichneumonid, *Xanthopimpla* sp., and a Sphegid, *Dolichurus* sp., but none occurred in appreciable numbers. Infestation of stored grain by insects was slightly reduced by a fertiliser dust and by wood ash, the latter being rather more effective.

FERNANDO (M.) & UDURAWANA (S. B.). **The relative Resistance of some Strains of Bitter-gourd to the Cucurbit Fruit-fly.**—*Trop. Agriculturist* **96** no. 6 pp. 347–352, 3 refs. Peradeniya, 1941.

The results are given of experiments in 1937–41 in Ceylon on the yield of five strains of *Momordica charantia* and the percentages of the fruits infested by *Dacus cucurbitae*, Coq. One strain was consistently superior to the others in regard to both resistance to the fruit-fly and yield.

Division of Entomology.—*Rep. Dep. Agric. Malaya 1940* pp. 7–8. Kuala Lumpur, 1941.

In investigations in Malaya in 1940, the penetration into tightly-packed stored rice of chloropicrin used alone or mixed with an equal quantity of carbon

tetrachloride at ten times the dosage normally employed did not exceed 5 ft. in four days. A few adults of *Calandra oryzae*, L., survived exposure to an atmosphere of almost pure carbon dioxide for 72 hours ; and an exposure of more than two weeks was necessary to destroy all stages of the weevil in infested rice. Feeding tests showed that sound rice is likely to be damaged only by *Calandra* and *Rhizopertha* [*dominica*, F.], and thoroughly dry grain only by *Rhizopertha* [*cf. R.A.E.*, A **30** 278, 279].

Stocks of six lowland Reduviid predators were reared and sent to the Cameron Highlands for liberation against *Helopeltis bradyi*, Waterh., and *H. cinchonae*, Mann, on tea. Subsequent examination showed that some species had become established ; the Capsids were extremely scarce at that time but the extent to which this can be attributed to the predators is uncertain.

VERBEEK (F. A. T. H.). **Draagstof voor derrispoeder.** [A Carrier for Derris Powder.]—*Bergcultures* **15** no. 44 pp. 1493–1497, 2 refs. Batavia, 1941.

In view of difficulties in the importation of talc into Java for use as a carrier for derris dusts [*cf. R.A.E.*, A **24** 765], laboratory tests, an account of which is given, were carried out on several local products, such as clays and pumice tuffs, as substitutes for it. Some of them proved satisfactory.

VERBEEK (F. A. T. H.). **Bestrijding van *Helopeltis* in thee door middel van derrisstuifmengsels.** [The Control of *Helopeltis* on Tea by Means of Derris Dusts.]—*Bergcultures* **16** no. 2 pp. 30–32, 1 fig. Batavia, 1942.

The information in this paper is based on replies to a questionnaire circulated to growers in June 1941. *Helopeltis* can normally be controlled on tea in Java by a derris dust with a rotenone content of 0·75 per cent., but the dust should be fresh and dry, and should preferably be applied in the early morning. Bushes that are producing shoots after pruning can be kept practically free from the bugs, while the infestation can be kept within permissible limits on bushes that are being regularly plucked. If the bushes are higher than about 5 ft., however, dusting is not profitable.

The plantations should be inspected regularly, at weekly intervals or in the normal process of plucking, and foci of infestation treated as soon as they appear. The rate of application for such selective dusting ranges from 2·7 to 7·2 lb. per acre, but if a heavy infestation spreads to the whole plantation up to 27 lb. per acre must be used, which is usually unremunerative.

TAKAHASHI (R.). **Some injurious Insects of agricultural Plants and Forest Trees in Siam and Indo-China. I. Aphididae.**—*Rep. Govt. agric. Res. Inst. Taiwan* no. 78, iii+27 pp., 9 figs., 4 refs. Taihoku, Formosa, 1941.

Records are given of the Aphids observed by the author during a recent visit to Indo-China and Siam, and of their food-plants. Eight new species and two new varieties are described. The 28 species from Siam include *Aphis gossypii*, Glov., the only Aphid previously recorded there, while two of the four species previously reported in Indo-China are now recorded from Siam. Five new records are made from Indo-China. The Aphids observed attacking economic plants include *Myzus persicae*, Sulz., on tobacco, *Rhopalosiphum pseudobrassicae*, Davis, on cabbage, *Aphis odinae*, v. d. G., on mango, *A. glycines*, Mats., on soy beans, *A. gossypii* on cotton, and *A. sacchari*, Zhnt., and *Oregma* (*Ceratovacuna*) *lanigera*, Zhnt., on sugar-cane, all in Siam, and *A. laburni*, Kalt., on beans in Siam and Indo-China.

Jones (W. W.), Storey (W. B.), Parris (G. K.) & Holdaway (F. G.). **Papaya Production in the Hawaiian Islands.**—*Bull. Hawaii agric. Exp. Sta.* no. 87, 64 pp., 24 figs., 59 refs. Honolulu, 1941.

This bulletin contains a section (pp. 45–51) dealing with the Athropods that attack papaya in Hawaii and their control. The most important are the mites, *Tetranychus telarius*, L. (*althaeae*, v. Hanst.), *Tenuipalpus bioculatus*, McG., and *Tarsonemus* (*Hemitarsonemus*) *latus*, Banks. All stages of *Tetranychus* occur on the lower surface of the leaves and also on the trunk. Infested leaves become yellowish-green and may exhibit white stippling, and if infestation is heavy, webbing occurs along the veins and in the angles between them. *Tenuipalpus* sometimes causes serious damage to the fruits, which develop grey scaly or cracked areas, most frequently at a point where they are in contact, with the trunk. *Tarsonemus* infests the lower surfaces of the leaves, which turn yellowish-green or yellow and are reduced in size ; in addition, the laminae become distorted, leathery and rough, and the tips curl downwards. Infestation may result in the death of the leader and the production of multiple shoots, or even in the death of the tree. All these mites are polyphagous, and notes on their food-plants are given from the literature. In Hawaii, *Tarsonemus* has been recorded from the young foliage of beans and jimson weed (*Datura stramonium*).

Clean cultivation is a preventive measure, since weeds are often a source of infestation ; in a papaya field in which weeds were left to prevent erosion, over 90 per cent. of the trees in the parts where *Datura stramonium* was most abundant became infested by *Tarsonemus*. All three mites can be controlled by dusts or sprays of sulphur, and experience has shown the latter to be more suited both to conditions in Hawaii, where winds are frequent, and to the papaya tree. Wettable sulphur at the rate of 5 lb. per 100 U.S. gals. water has given good control, and finely divided colloidal sulphur in the form of a paste was still more effective but may be too expensive for economic use.

Aphids and thrips sometimes damage newly-planted papaya trees, especially if growth is retarded. *Myzus persicae*, Sulz., is the most abundant Aphid, and *Macrosiphum solanifolii*, Ashm. (*gei*, auct.), and *Aphis gossypii*, Glov., are next in importance. All three occur on the lower surfaces of the leaves ; the edges of heavily infested leaves curl and become yellowish-green in colour, and the petioles hang down in a manner similar to those of trees affected by mosaic disease. Young leaves infested with *Thrips tabaci*, Lind., which breeds readily on papaya, become distorted and blotched with white. Both Aphids and thrips can generally be controlled by a spray of 1 U.S. quart nicotine sulphate and 6 lb. soap in 100 U.S. gals. water.

Laphygma exigua, Hb., and *L. exempta*, Wlk., oviposit on the leaves, but the larvae of the latter do not feed on papaya, and those of the former, although capable of completing part of their development on it, remain on it for only a very short time. *Ceratitis capitata*, Wied., oviposits in the ripe and over-ripe fruits, but does not attack those in the mature green stage in which they are normally harvested.

Machado (A.). **Estudo químico do oleo pardo (Essência de *Myrrocarpus sylvestris*). Emprego em perfumaria, em medicina e como inseticida.** [A chemical Study of the essential Oil of *M. sylvestris*. Its Use in Perfumery and Medicine and as an Insecticide.]—*Rev. Quím. industr.* **10** no. 112 p. 14. Rio de Janeiro, 1941.

Examination of the seeds of *Myrrocarpus sylvestris*, a leguminous plant that grows in Brazil, showed them to contain about 0·5 per cent. of an essential oil, stated to be of high insecticidal value, that is composed of 25·4 per cent. cineol, 65·8 per cent. terpineol, 6·5 per cent. terpenes and 2·3 per cent. undetermined components.

Reeks (W. A.). **On the taxonomic Status of** *Gilpinia polytoma* **(Htg.) and** *G. hercyniae* **(Htg.). (Hymenoptera, Diprionidae).**—*Canad. Ent.* **73** no. 10 pp. 177–188, 44 figs., 11 refs. Guelph, Ont., 1941.

The author gives translations of the original descriptions of *Gilpinia* (*Lophyrus*) *polytoma*, Htg., and *G.* (*L.*) *hercyniae*, Htg., and concludes from them that the name *G. polytoma* should be restricted to a form already noticed [*cf. R.A.E.*, A **29** 474], which reproduces by arrhenotokous parthenogenesis and is known only from Europe, and that *G. hercyniae*, which has been considered a synonym of it, is the thelytokous form [*loc. cit.*] that also occurs in Canada and the United States. He then redescribes both sexes of each species and gives notes on their distribution and the species of spruce [*Picea*] attacked by *G. hercyniae* in North America. *P. abies* (*excelsa*) is the recorded food-plant of *G. polytoma*. Both species were originally described from Germany, and the author has examined specimens of both from Czechoslovakia, Sweden and Finland. In conclusion he gives a key to the adults of each sex of these two species and of *G. abieticola*, D.T., a third European spruce sawfly that resembles them in the male sex, and briefly records the finding, in a mixed lot of adults reared from larvae taken on spruce in Finland, of males that appear to represent yet another species of the genus.

Prebble (M. L.). **The Diapause and related Phenomena in** *Gilpinia polytoma* **(Hartig). I. Factors influencing the Inception of Diapause.**—*Canad. J. Res.* (D) **19** no. 10 pp. 295–322, 3 figs., 85 refs. Ottawa, 1941. **II. Factors influencing the Breaking of Diapause.**—*T.c.* pp. 323–346, 2 figs., 6 refs.

In the first of these papers, which initiates a proposed series of five, the author reviews the literature on the causes of diapause in insects and points out that it is of fundamental importance in the case of the European species of *Gilpinia* that occurs on spruce in Canada and the United States, since, through variations in diapause, it is adapted to climatically different regions where different numbers of seasonal generations are produced. He draws attention in a foot-note to the fact that the species in question is not *G. polytoma*, Htg., but an allied European species [*G. hercyniae*, Htg. (see preceding abstract)].

An outline of the life-cycle of *G. hercyniae* in Canada is given, with details of the developmental stages within the cocoon and of the genetic and environmental factors that influence the inception of diapause. It was found that comparatively large proportions of the population in south-central New Brunswick can be established as continuously developing lines (emergent stock) in optimal conditions, though a small and variable percentage of the progeny diapauses, but that there also exist lines that either fail to develop beyond the first generation, or in which the tendency towards diapause is so great that subsequent generations are reared with difficulty. The Gaspé population, on the other hand, appeared to be composed predominantly of lines in which diapause intervenes after a single generation, and, to a less extent, of partially emergent lines. Some stocks transferred from New Brunswick to Gaspé continued to produce two generations in the year, though others went into diapause in the first generation ; the second-generation larvae were only partly developed in early October, when they were killed by the onset of winter conditions. Only about 1 per cent. of the first generation of Gaspé stock transferred to south central New Brunswick developed without diapause under conditions in which a large proportion of the native stock does so. There are therefore genetic differences within the species with respect to the capacity for development without diapause.

The effect of environmental factors was studied by rearing emergent lines at various temperatures and on different types of foliage. It was found that

fluctuating or very low temperatures during the first three instars do not necessarily induce diapause, and that diapause may be caused by fluctuating and sub-optimal temperatures during the latter part of active larval development. Although, in a two-generation area, the percentage of larvae that diapaused was uniformly low in incubator populations and variable in outside populations early in the year, it was 100 in all outside populations late in the year, in the progeny of females reared either in the incubator or outside. The diapause induced in the emergent lines was in most cases overcome by a short period of cold-rest, though without this, development was not resumed. The percentage of diapause was highest in larvae reared on new needles of white spruce [*Picea glauca*] early in the year, and gradually declined until, in those reared in late autumn and winter, it was identical on the current year's foliage and on the standard food (young and old foliage of white spruce).

In studies on the inception of diapause in field populations, carried out in a two-generation area, it was found that the percentage of larvae that diapaused was least among those that developed at distinctly less favourable temperatures (62–66°F.) in June and early July, a rapid increase coinciding with a marked improvement in temperature (69–71°F.) during late July and early August; that there was no correlation between mean or minimal temperature within the range experienced, or between precipitation in the various periods, and the percentage of diapause; that conditions after the spinning of the cocoons were not obviously related to the percentage of diapause, since the greatest increase in the latter occurred during late July and early August while temperature conditions were equally favourable for about another month and the precipitation rate did not differ significantly; and that variability in temperature has little to do with the inception of diapause in field populations. Analysis of the data fails to provide evidence that the inception of diapause in the field is intimately related to food, temperature or precipitation, and the rearing experiments throughout the year indicate the unimportance of sunlight and cyclical changes in the daylight period. It is considered certain that diapause in emergent stock is determined by environment, since it is eliminated or relatively infrequent in the absence of environmental fluctuations, but no one factor is likely to be the sole cause of diapause in this sawfly, which is evidently highly sensitive to a changing environment, with the result that diapause in emergent stock increases progressively as the season advances.

The second paper comprises an account of laboratory and field experiments to determine the influence of factors operative in the natural habitat on the breaking of the diapause. In Gaspé, the percentage of larvæ that developed in overwintering cocoons transferred to favourable conditions of temperature and moisture was low in early autumn, but gradually increased in samples left in cold storage for progressively longer periods, reaching a maximum for samples incubated in January or February, whereas a very high percentage of the larvae developed in all series of New Brunswick cocoons incubated at 74°F. and 100 per cent. relative humidity from early December onwards.

It was found that cold-rest was as effective at temperatures of 30–45°F. as at fluctuating temperatures in the ground, mostly below freezing point, or at widely varying temperatures (14–35°F.), but there was virtually no emergence after six months from cocoons incubated at 50°F. from mid-October, presumably owing to the inadequacy of rest at this temperature for overcoming diapause, since the threshold of development is known to be below 45°F. After cold-rest, temperatures varying between 45 and 65°F. had little effect on the percentage of larvae that resumed development, though the speed of development was directly affected, but a temperature of 75°F. had a more stimulating influence than one of 65° or lower. Temperatures in the field are lower and fail to promote such extensive emergence as may be obtained in the laboratory.

Contact with moisture during cold-rest had a slight stimulating effect on subsequent development, if no moisture was provided during incubation, but

was without effect if the cocoons were kept moist during incubation. Moisture supplied during the incubation period, by placing the cocoons on moist sand, by frequent momentary dipping or by immersion for 1–3 days, had no effect on the uniformly high rate of development of material from New Brunswick that was incubated at 74°F. and 100 per cent. relative humidity. In general, there was increased development of Gaspé material as the duration of contact with water or the frequency of dipping was increased. Infrequent dippings were of no benefit when the cocoons were in an unsaturated environment between dippings. The temperature of the water during contact appeared to be of no importance when it was within the limits of 32 and 74°F., the essential requirements being the addition to the cocoon wall of water that is subsequently utilised by the contained larva if the temperature is favourable to development and the external environment so humid that the moisture gained is not lost by evaporation. Experiments on the influence of atmospheric humidity showed that the percentage of larvae developing was reduced in all unsaturated environments, though a few developed even in the driest one ; that the benefit of an initial contact with water for varying periods was reduced in relation to the degree of unsaturation of the environment to which cocoons were later exposed ; and that drying of the cocoons reduced the capacity to benefit from subsequent contact with water, in relation to the amount of initial drying.

Owing to the relation between external moisture and the resumption of development after diapause, the influence of the cocoon in regulating water exchanges was investigated. It is apparently the only mechanism for the conservation of moisture, but it does not render the larva independent of the external environment, since it merely delays the outward diffusion of moisture that occurs in unsaturated environments. The micro-climate within the cocoon appears to be kept near the saturation point by moisture from the larva, as only this condition can account for water loss from larvae observed in the most humid environments tested, so that there is a continuous loss of water from the larval tissues to replace the moisture that diffuses through the cocoon in dry air. When cocoons were placed in contact with moisture, the outer walls became saturated within a short time, but absorption of water by the larvae was very gradual ; there was no evidence of a relation between duration of cold-rest and ability to absorb water, and individuals that had lost about 8–9 per cent. of their contained water during earlier drying failed to compensate for this loss during immersion for two days and storage at 100 per cent. relative humidity for 16 days. The absence of soil moisture, especially if accentuated by unusually warm weather in spring or early summer, may, therefore, have consequences on seasonal development extending well beyond the first rainfall.

The lack of direct influence of variations in temperature within the limits normally experienced in the natural habitat on the percentage of development in overwintered cocoons was confirmed by the results of field studies, in which cocoons collected in Gaspé in spring were subjected to the full range of variability in temperature conditions available in the Gaspé forest. Investigations on the effect of controlled moisture conditions and rainfall and the analysis of weather conditions associated with abnormal development indicated that moisture conditions during the winter, or prior to the spring rise in temperature above the threshold of development, have little effect on seasonal development in a natural population. Moisture deficiency at the time of normal spring development is likely to have adverse effects, which are different in one-generation and two-generation areas. In the latter, many individuals that fail to develop at the normal time respond to moderate rainfall later in the season, so that the chief result of dry spring weather is a protraction of the emergence period. In the former, continual contact with moisture from early June increased development by about 9–10 per cent. in two experiments, and excessive rainfall in July and August 1939 increased development in central Gaspé populations by 4–5 per cent., but it is unlikely that overwintered

populations respond perceptibly to increased moisture after mid-June. The effect of unseasonably dry conditions in the spring is, therefore, to reduce still further the low percentage of development in the overwintered populations characteristic of a one-generation area.

CARPENTER (T. L.). **Plant Sprays. A Report on the Feasability of the Use of Household Insecticides for Plant Spray Purposes.**—*Soap* **17** no. 8 pp. 102–104 ; no. 9 pp. 105, 107, 109, 7 refs. New York, N.Y., 1941.

The author briefly recounts the history of the use of petroleum oils in sprays for the control of insects pests on plants. Recent work in the United States has shown that undiluted low-boiling petroleum distillates constitute an excellent vehicle for insecticides, but the action of such sprays on the plant has been little studied. In view of this and of a desire to evolve a household spray that would also control insects on plants, experiments were begun in Wisconsin in 1937. Those described in the first part of the paper, which have already been noticed from another source [*R.A.E.*, A **29** 246], showed that a distillate having a viscosity of approximately 1·7 centistokes that had been treated with 100 lb. fuming sulphuric acid per barrel could safely be used on the foliage of plants if properly applied.

The experiments described in the second part were designed to test the phytocidal effects of the commoner toxic ingredients that are incorporated in household sprays. When bean plants were sprayed with a wide range of dilutions of certain synthetic compounds employed as substitutes or activators for pyrethrum as well as of several intermediate solvents of rotenone [*cf.* **29** 349, etc.] and nicotine (including butyl alcohol), oil-soluble fungicides and pyrethrum extracts, all applied in an oil base known as Sinclair's Insecticide Base, pyrethrum was the only substance that did not injure the foliage. Tests in which 72 species of economic plants were sprayed with Sinclair's Insecticide Base, a slightly heavier experimental fraction and two other insecticide bases that are recommended for plant sprays showed that vegetables and fruit trees were quite tolerant of the oils ; ornamental plants, though less tolerant, showed a relatively high degree of resistance ; leguminous plants were more susceptible to injury than solanaceous plants, and crucifers were the least susceptible of the plants tested. Certain morphological characteristics appeared to govern the variance in resistance to oil injury. In related studies, it was found that immature leaves were more easily injured than mature or old ones ; that undiluted oil sprays did not affect normal fertilisation or fruit-set in the plants tested, although the petals and sepals were very easily injured ; and that ripened seed could be sprayed without affecting normal germination. Only two of 48 common household sprayers proved suitable for the application of insecticides to plants. When cabbage and tomato plants in the greenhouse and cabbage, tomato and potato plants in the field were given 1–4 applications of a household spray, there was a general dwarfing of all parts of both root and shoot of greenhouse plants that had been sprayed four times, but no significant toxic effect on field plants, probably owing, in part, to their greater hardiness. It is concluded that it would be unsafe to use more than three applications of an undiluted distillate on greenhouse plants. A limited number of tests with a representative group of phytophagous insects commonly found on vegetables and ornamental plants showed that sprays containing typical percentages of the usual oil-soluble contact insecticides would, for the most part, effectively control them.

From the results obtained in these investigations, it is concluded that, although certain household sprays are not injurious to plants if properly applied, the production of dual-purpose sprays for general use is not to be recommended.

Park (T.), Gregg (E. V.) & Lutherman (C. Z.). **Studies in Population Physiology. X. Interspecific Competition in Populations of Granary Beetles.**—*Physiol. Zool.* **14** no. 4 pp. 395–430, 14 figs., 22 refs. Chicago, Ill., 1941.

The following is based on the authors' summary. In an attempt to analyse the effect of interspecific competition on population growth, *Tribolium confusum*, Duv., *Gnathocerus cornutus*, F., and *Trogoderma versicolor*, Creutz., were kept in a medium consisting of 70 per cent. wheat flour, 28 per cent. rolled oats and 2 per cent. dry yeast, and counts of the total populations and of the larvae, pupae and adults were made monthly. In addition to populations of one species only, set up as controls, there were sets of cultures containing each combination of two species in which the initial populations of the species were equal or unequal. In populations containing *Tribolium* and *Trogoderma*, the latter always became extinct, while in those of *Tribolium* and *Gnathocerus* the latter died out unless the population of *Tribolium* was reduced to a low point owing to epidemic or other causes, in which case *Tribolium* became extinct. In cultures containing *Trogoderma* and *Gnathocerus*, the former became extinct unless its initial numbers were greater. When equal numbers of all three species were cultured together, *Trogoderma* quickly died out, and at the time of writing it seemed likely that *Gnathocerus* would also disappear.

Wilbur (D. A.), Fritz (R. F.) & Painter (R. H.). **Grasshopper Problems associated with Strip Cropping in western Kansas.**—*J. Amer. Soc. Agron.* **34** no. 1 pp. 16–29, 5 figs., 7 refs. Geneva, N.Y., 1942.

In Greeley County, western Kansas, large areas are farmed in strips, about 55 yards wide and half a mile long, as a measure against erosion of soil by wind. Wheat is the main crop, and on half the strips it is harvested while the alternate strips are usually fallow. The commonest species of grasshopper is *Melanoplus mexicanus*, Sauss., which prefers to oviposit on stubble lands, weedy idle lands, overgrazed pastures and roadsides. The stubble on the strips for fallow can usually be ploughed before the overwintering eggs have hatched, and large grasshopper populations of this generation do not develop on the ploughed strips. In favourable seasons in this region, however, *M. mexicanus* has a second generation, the hatching of which may coincide with the germination of winter wheat, and strips under the latter are invaded by grasshoppers migrating from stubble strips or from grazing land. The extent of the damage, therefore, depends on the extent of the field margins, which is naturally very great in strip-planted wheat. Surveys showed that strips of winter wheat bordered by small-grain stubble or by pastures suffer much greater injury than those bordered by sorghums, even though considerable populations of grasshoppers are present in sorghum ; this suggests that even a partial replacement of wheat or barley by sorghum tends to alleviate the losses from grasshoppers. The improving of the condition of pastures and the elimination of the roadside strips favoured by *M. mexicanus* are also desirable. In the control campaign in 1940, it was observed that injury by grasshoppers was much less when bait was distributed before sowing wheat than when it was distributed after sowing.

Allred (B. W.). **Grasshoppers and their Effect on Sagebrush on the Little Powder River in Wyoming and Montana.**—*Ecology* **22** no. 4 pp. 387–392, 3 figs., 2 refs. Brooklyn, N.Y., 1941.

Severe drought in 1936 in a prairie district in north-eastern Wyoming and south-eastern Montana was accompanied by a grasshopper outbreak, the dominant species being *Aulocara elliotti*, Thos., and *Ageneotettix deorum*, Scud., and the density of the infestation during the nymphal stage was 50–100 per sq. ft. As a result, approximately 50 per cent. of the big sagebrush (*Artemisia tridentata*) was killed, the losses being greatest on heavy clay soils with a south-western exposure and on ranges with a high percentage of grasses.

Dahms (R. G.) & Osborn (W. M.). **Effect of certain Weather Conditions on Chinch Bug Abundance at the Dry Land Field Station of the United States Department of Agriculture at Lawton, Okla., 1916–40.**—*Ecology* **23** no. 1 pp. 103–106, 4 refs. Lancaster, Pa., 1942.

Data are given for 1916–40 showing that infestation of sorghums by the chinch bug [*Blissus leucopterus*, Say] at a field station in Oklahoma was light in years following years in which the rainfall between 10th July and 20th August was low. Winter temperatures, winter barley survival and rainfall during May and June did not appear to be correlated with outbreaks.

Flint (W. P.). **Found—an Insect Enemy of Soybeans.**—*Soybean Digest* **1** no. 7 p. 4, 1 fig. 1941. (Abstr. in *Exp. Sta. Rec.* **85** no. 5 p. 645. Washington, D.C., 1941.)

A brief account is given of the grape colaspis [*Colaspis brunnea*, F.], the larvae of which seriously damaged soy beans over thousands of acres in Illinois during the past three years, reducing the crop by 10–50 per cent. or more. The adults of this Eumolpid feed on the leaves of a large number of plants, including grape-vines, leguminous plants and smartweed [*Polygonum*], the petals of flowers and the silks of maize. They emerge from the soil during July and early August, and the females oviposit in late July and early August. The larvae hatch in about two weeks and feed until the weather becomes cool, when they migrate downward in the soil, passing the winter at a depth of 6–8 ins. Most of the injured plants were in fields in which soy beans had been grown in the previous year, and damage appeared to increase rapidly when they were grown in the same soil for three successive years. The most effective control measures are autumn ploughing or early spring ploughing of legume sod, followed by as many diskings as seem economically practicable. If maize is to follow soy beans, it should be sown as late as possible. Injury was noted only on soy beans that followed other soy beans or red clover.

Boyce (A. M.) & Kagy (J. F.). **DN-Dust in Control of the Citrus Red Mite.**—*Citrus Leaves* **21** no. 4 pp. 5–6, 13, 19, 22, 1 fig. 1941. (Abstr. in *Exp. Sta. Rec.* **85** no. 5 pp. 649–650. Washington, D.C., 1941.)

In work with DN-Dust, a proprietary dust containing 1 per cent. dinitro-ortho-cyclohexylphenol, described more specifically as 2-4-dinitro-6-cyclohexylphenol, that has given satisfactory results against the citrus red mite [*Paratetranychus citri*, McG.] in California [*cf. R.A.E.*, A **27** 261, 650], a volcanic ash material (Frianite) was found to be a better diluent than walnut-shell flour and was substituted for it in DN-Dust mixtures, chiefly because of its superior depositing qualities on fruit and foliage. DN-Dust-D-8, an improved material containing 1·7 per cent. dicyclohexylamine 2-4-dinitro-6-cyclohexylphenate and an adhesive [**29** 561], when used at the rate of 1 lb. per tree gave deposits on mature fruits equal to those given by DN-Dust at the rate of 1½ lb. per tree. In many districts, control for many months is given by a single application of DN-Dust. The active stages of the mite are killed within 1–4 days of the application; those that are quiescent or moulting at the time of treatment become active within 3 days and are destroyed when they come in contact with the deposit, and the mites that hatch within 4 days of the treatment are also killed. Those that hatch after this period can be controlled by a second application 10–28 days after the first. Methods of application, the use of the dust in seasonal programmes and two general types of injury that have been observed are discussed.

Snelling (R. O.). **Resistance of Plants to Insect Attack.**—*Bot. Rev.* **7** no. 10 pp. 543–586, 567 refs. Lancaster, Pa., 1941.

The author uses the word resistance to include those characteristics that make a plant more able to avoid, tolerate or recover from, the attacks of insects than are other plants of the same species. He reviews the literature on the subject and gives tables, which serve as an index to the bibliography, showing records of plant resistance to insects, involving nearly 100 species of plants and over 100 species of insects, plant characteristics that may have an influence in resistance to attack, and successful work on breeding plants for resistance to insects.

Patch (L. H.), Still (G. W.), App (B. A.) & Crooks (C. A.). **Comparative Injury by the European Corn Borer to open-pollinated and hybrid field Corn.**—*J. agric. Res.* **63** no. 6 pp. 355–368, 3 figs., 3 refs. Washington, D.C., 1941.

The following is the authors' summary. The amount of injury to the quality and yield of the ears of field maize and the breakage of the stalks by infestations of the European corn borer, *Pyrausta nubilalis*, Hb., were determined for hybrids and for the Clarage variety and other open-pollinated varieties in Ohio from 1929 to 1933. The various strains were subjected to different known levels of borer population induced by placing egg masses on the plants by hand. The regression of the factors studied on the borer population per plant was determined. The reduction in the marketable yield occurred through an increase in the number of earless plants and plants bearing unmarketable ears and through a reduction in the size of the ear on all plants bearing marketable ears.

The total reduction in marketable yield per acre per borer per plant was equivalent to the yield of about 292 hybrid or open-pollinated plants bearing marketable ears in the absence of borers. The size of the marketable ears was reduced about 2·50 per cent. per borer per plant in both the hybrids and the open-pollinated varieties. On the basis of the marketable yield in the absence of borers, the marketable yield of the hybrids was reduced 2·99 per cent. and that of the open-pollinated varieties 3·64 per cent. per borer per plant. The hybrids were therefore more tolerant to the borer than the open-pollinated varieties. This advantage was due to the difference in the rate of increase per borer per plant in the number of earless plants and of plants bearing unmarketable ears per acre.

About 3·5 per cent. of the hybrid plants and 10·5 per cent. of the open-pollinated plants would have been broken below the ear in the absence of borers. Up to seven borers per plant, the percentage of plants broken below the ear of both types of plants increased at the rate of about 1·47 per borer per plant. The hybrid plants therefore showed less breakage in the presence of borers only because they stood up better without breakage in the absence of borers. In the Clarage variety, 59·0 per cent. of all broken plants, excluding broken tassels, were broken below the ear on plants infested at levels up to 10 borers per plant.

Ficht (G. A.) & Hienton (T. E.). **Some of the more important Factors governing the Flight of European Corn Borer Moths to electric Traps.**—*J. econ. Ent.* **34** no. 5 pp. 599–604, 4 refs. Menasha, Wis., 1941.

An account is given of further investigations on the use of electric light traps for the control of the European corn borer [*Pyrausta nubilalis*, Hb.] on maize in Indiana [*cf. R.A.E.*, A **28** 175; **30** 74]; they were concerned principally with the main factors affecting the flight of the moths to the traps, as a means of further increasing the number caught. In laboratory studies during 1939

and 1940, it was found that the numbers of moths attracted to light with visible intensities of 250, 500, 1,000 and 2,000 foot-candles were proportionate to the intensity, and further tests with lower and higher intensities (up to 10,000 foot-candles) confirmed that the moths selected the light of highest visible intensity. When the intensity of light was constant, the greatest numbers of moths were attracted to lamps with the largest luminous areas. Lamps radiating the greater part of their visible energy in the violet-blue band of the spectrum attracted many more moths than those radiating chiefly in the orange-red band ; moths showed no preference for ultraviolet radiation, under the conditions of the experiments, and slightly fewer were attracted to lamps emitting ultraviolet radiation with wavelengths below 3,200 Ångstrom units.

In field experiments in 1940, traps were placed 10 ft. above ground level at three topographical levels, differing in height by 5·5 ft. Significantly more moths were caught in traps at the high contour than at the low, but there was no significant difference in the captures from the high and intermediate contours, possibly owing to difference in the height of the plants, which averaged 62·6, 67·7 and 63·1 inches at the high, intermediate and low contours, respectively [*cf.* **30** 74]. As long as the height of the maize was less than 5 ft., traps at this height caught more moths than those 10 and 15 ft. above ground level, and when the plants exceeded 5 ft. in height, traps at the height of the maize caught more than the higher ones. No significant difference was noted in catches from four types of traps having differently shaped electrocutor grids.

Bigger (J. H.), Snelling (R. O.) & Blanchard (R. A.). **Resistance of Corn Strains to the Southern Corn Rootworm,** *Diabrotica duodecimpunctata* **F.**—*J. econ. Ent.* **34** no. 5 pp. 605–613, 3 figs., 22 refs. Menasha, Wis., 1941.

Observations on the resistance of maize to attack by larvae of *Diabrotica duodecimpunctata*, F., made at several localities in Illinois in 1937–39, indicated the possibility of reducing injury by the use of resistant strains ; no other method of control has proved satisfactory.

Adults of *D. duodecimpunctata* migrate to Illinois in May from the south, where the larvae damage young maize by burrowing into the growing bud near the surface of the soil, and two generations, of which the adults appear in early August and in late September and early October, occur in Illinois in years in which it is a factor in reducing maize production. Damage in the maize belt consists of root pruning and tunnelling and occurs when the plants are more advanced in growth. It causes increases in the lodging of the plants, in the moisture content of the ears at harvest and in the proportion of poorly filled ears and unsound maize, and decreases in the weight, length and diameter of the ears. Pollination may be affected adversely by lodging at tasselling time, and mechanical harvesters cannot be used if the plants are lodged or are not firmly rooted.

The resistance of strains to damage by the larvae was measured by their resistance to lodging, caused by the failure of the root system to hold the plants erect, on soil known to be infested with the Galerucid. Data obtained for inbred lines and single crosses indicate a differential response of the plants, resistance being heritable. The Indiana inbred line 38–11 was outstanding in its resistance to lodging after attack and transmitted the resistance to hybrids. Some inbred lines suffered markedly less leaf injury from the feeding of the adults than other lines grown in the same experiment.

Balduf (W. V.). **Quantitative Dietary Studies on** *Phymata*.—*J. econ. Ent.* **34** no. 5 pp. 614–620, 2 figs., 3 refs. Menasha, Wis., 1941.

The results of the studies described, in which nymphs and adults of the predacious bug, *Phymata pennsylvanica americana*, Melin, were fed on adults

of *Drosophila melanogaster*, Mg., and *Musca domestica*, L., showed that the average survival and rate of development of the nymphs and the average length of life, weight, size, mating activity and fecundity of the resulting adults were to a large degree proportional to the quantity of prey allowed, other factors being equal. The author concludes from these results that when not restricted to one generation per year, as *Phymata* is by a diapause in the egg, well-fed predators probably tend to produce at least one more additional cycle yearly than undernourished individuals of the same species, such accelerated growth being due to reductions in the nymphal stage and the preoviposition period. Moreover, the comparatively large and vigorous adults not only have a greater capacity for destroying the insects on which they feed, but also yield a much larger number of offspring, which results in the multiplication and acceleration of the control value of those that attack injurious insects. On the basis of one generation per year only, the average individual male and female of *P. p. americana* destroyed the equivalent of 72 and 122 house-flies, respectively, when provided with an adequate amount of prey.

MIDDLEKAUFF (W. W.). **Some biological Observations of the Adults of the Apple Maggot and the Cherry Fruitflies.**—*J. econ. Ent.* **34** no. 5 pp. 621–624, 3 figs., 7 refs. Menasha, Wis., 1941.

In the course of toxicological studies [*cf.* next abstract], observations were made on the biology of adults of *Rhagoletis pomonella*, Walsh, *R. fausta*, O.-S., and *R. cingulata*, Lw., bred from larvae that emerged from infested fruits collected in New York and pupated in sand. The puparia were recovered by flotation in water, kept in refrigerators for several months and then placed in moist sphagnum moss and kept at room temperature until emergence took place. The mean weights of males and females of *R. pomonella*, *R. fausta* and *R. cingulata* were 4·6 and 6·9, 3 and 4·1, and 3·8 and 5·1 mg., respectively; the flies were 24 hours old when weighed and had been provided with food and water on emergence. Ten adults of *R. pomonella* that were confined in individual vials and supplied with rose leaves covered with honeydew excreted by *Macrosiphum rosae*, L., and with fresh water lived for an average of 26·1 days, whereas most starved insects died within four days, though a few survived for five. Tests of whether adults of *R. pomonella* can perceive food by means of tarsal chemoreceptors gave negative results. Parasites bred from the puparia, comprised *Opius lectus*, Gah., *O. ferrugineus*, Gah., *Aphaereta muscae*, Ashm., an undescribed species of *Galesus* and an undetermined Eulophid from *R. pomonella*, a species of *Opius* belonging to the *lectus-lectoides* complex, *Pachycrepoideus dubius*, Ashm., and an undetermined species of *Eucoila* from *R. fausta*, and *O. ferrugineus* from *R. cingulata*.

MIDDLEKAUFF (W. W.) & HANSBERRY (R.). **Toxicological Studies with Adults of Apple Maggot and Cherry Fruitflies.**—*J. econ. Ent.* **34** no. 5 pp. 625–630, 4 figs., 5 refs. Menasha, Wis., 1941.

The authors describe experiments to determine the comparative toxicities of trivalent and pentavalent arsenic and the toxicity of certain nicotine compounds, Reinecke's salt (ammonium tetrathiocyanato diammino chromium) and a miscellaneous group of insecticides to adults of *Rhagoletis pomonella*, Walsh, *R. cingulata*, Lw., and *R. fausta*, O.-S., which were reared from puparia by a method that is described [*cf.* preceding abstract). The median lethal doses of trisodium arsenite and trisodium arsenate were calculated for these species by a technique whereby individual flies were fed on solutions, dosage being determined by weight differences. No differences in the toxicities of trivalent and pentavalent arsenic were observed. The median lethal doses of

trisodium arsenite and trisodium arsenate for *R. pomonella* were 0·10 and 0·09 mg. arsenic (As) per gm. body weight, respectively, as compared with 0·08 and 0·07 mg. for *R. cingulata*; the median lethal dose of trisodium arsenite for *R. fausta* was 0·07 mg. arsenic.

The median lethal dose for *R. pomonella* of Reinecke's salt, the most toxic substance tested, was 0·0079 mg. per gm. in individual feeding tests. Compounds of nicotine were generally too repellent or too emetic in individual tests to be effective [*cf. R.A.E.*, A **29** 206], although some compounds were given in 10 per cent. honey instead of distilled water. Nicotine alkaloid was repellent at the lowest concentration used, 0·0156 mg. per ml. Although insolubility or distastefulness or a combination of the two precluded the measurement of nicotine dosages, the flies were weighed before and after being given food to ascertain whether or not they had fed. No correlation between the solubility of the nicotine compounds and their repellency was observed.

In laboratory cage tests based on the time required for 50 per cent. mortality, Reinecke's salt and nicotine reineckate were the most effective compounds tested against *R. pomonella*, followed by calcium arsenate, nicotine silicotungstate, lead arsenate, synthetic cryolite, nicotine bentonite, magnesium arsenate, phenothiazine (thiodiphenylamine) and barium fluosilicate. Flies fed on the last two substances lived longer than controls fed on sucrose solution alone. *R. fausta* was also killed more rapidly by calcium arsenate than by lead arsenate and was more susceptible than *R. pomonella* to both. Adults of *R. pomonella* and *R. fausta* were caged with no other food than apples sprayed with lead arsenate in 20 per cent. sucrose for seven and four days, respectively, before 50 per cent. mortality was obtained.

Norton (L. B.) & Billings (O. B.). **Characteristics of different Types of Nicotine Sprays. I. Nicotine Residues.**—*J. econ. Ent.* **34** no. 5 pp. 630–635, 8 figs., 2 refs. Menasha, Wis., 1941.

An account is given of field experiments in New York State with eight nicotine sprays [see also next abstract], and of the results obtained with respect to the nicotine residues. The sprays contained, per 100 U.S. gals. water, 1·1 U.S. pint nicotine oleate (35 per cent. nicotine) or 1 U.S. pint nicotine sulphate (40 per cent.) each with 2 U.S. quarts petroleum oil or rapeseed oil, 4 lb. nicotine peat (10 per cent.) with 2 U.S. quarts rapeseed oil or 1 U.S. pint blown rapeseed oil, or 3 U.S. pints nicotine pectate (15 per cent.) or 3 lb. nicotine bentonite (15 per cent.), each without oil, and were applied on 26th June and 8th and 19th July against first-generation larvae of the codling moth [*Cydia pomonella*, L.], and on 8th–9th August against the second generation, to apple trees that had received a delayed dormant spray of oil and nicotine sulphate and pink, calyx and first cover sprays of lead arsenate and lime-sulphur. A number of samples were taken, the first within two or three minutes of spraying, the second 2–5 hours later, as soon as the spray had completely dried, the third on the following day, and the others after gradually lengthening periods; the residues were removed from the fruit as soon as the samples were collected, to eliminate loss of nicotine during transport. From the results obtained it is concluded that the most rapid loss of nicotine normally occurs during the drying of the spray; that the amounts of nicotine originally deposited by soluble nicotine and oil combinations are nearly as high as those by fixed nicotines, but the fixed nicotines lose only a small proportion of the original deposit during drying, whereas the soluble nicotines may lose more than 75 per cent. during this process; that nicotine oleate and nicotine pectate yield a lower deposit than nicotine sulphate at the same concentration, probably because of run-off due to superior wetting properties, and are lost from the fruit more rapidly and completely, probably because of lower chemical stability; that nicotine peat with rapeseed oil and nicotine bentonite without oil give about the same deposit and residue,

but nicotine peat with blown rapeseed oil gives less, under the experimental conditions ; that mineral oil and rapeseed oil show no apparent differences in either amount or permanence of deposit with nicotine sulphate or with nicotine oleate ; and that combinations of nicotine with oil are less strongly affected by rain than the fixed nicotines.

HANSBERRY (R.). **Characteristics of different Types of Nicotine Sprays. II. Codling Moth Control.**—*J. econ. Ent.* **34** no. 5 pp. 636–638. Menasha, Wis., 1941.

To determine the effectiveness of the nicotine sprays described in the preceding paper for the control of the codling moth [*Cydia pomonella*, L.] on apple in New York, counts were made every 10 days from 10th July to estimate the degree of infestation on the tree, the total numbers of infested and clean fallen fruits and the degree of spray injury to fruits and foliage. At harvest, complete counts were made of both picked and dropped fruits, and the former were examined for infestation, " stings " and injury due to *Spilonota ocellana*, Schiff., or *Eulia* (*Argyrotaenia*) *velutinana*, Wlk. Although differences in control were small, it is tentatively concluded that rapeseed oil is slightly inferior to petroleum oil for the control of *C. pomonella*, and significantly so when used with nicotine oleate, though the two oils had differed little in ovicidal action in the laboratory ; that, under the conditions of the experiment, there were no significant differences between the degrees of control given by a soluble nicotine and oil (nicotine sulphate and petroleum oil), a fixed nicotine and oil (nicotine peat and rapeseed oil) and a fixed nicotine without oil (nicotine bentonite) ; that the difference in effectiveness between a schedule including 2 quarts rapeseed oil per 100 gals. (which was a good ovicide in the laboratory) and one including 1 pint blown rapeseed oil (which was not) was almost proportional to the difference in the nicotine residues ; and that the superiority in control of nicotine sulphate over nicotine oleate and of nicotine bentonite over nicotine pectate may have resulted from the higher deposits. The application of petroleum or rapeseed oil 10 days after the first cover spray, which contained lime-sulphur, resulted in no damage to the trees, but noticeable yellowing and slight roughening of the skin round the calyx of the fruit occurred after the third cover spray on the trees most heavily sprayed with rapeseed oil. The residues from the sprays of nicotine peat and oil persisted until harvest as a dirty black deposit, and sometimes caused roughening of the skin that made removal by wiping difficult.

Although no fungicide was used after the first cover spray, the orchard was almost entirely free from scab at harvest.

CHAPMAN (P. J.), PEARCE (G. W.) & AVENS (A. W.). **The Use of Petroleum Oils as Insecticides. III. Oil Deposit and the Control of Fruit Tree Leafroller and other Apple Pests.**—*J. econ. Ent.* **34** no. 5 pp. 639–647, 2 figs., 3 refs. Menasha, Wis., 1941.

The authors give the detailed results of experiments on mature apple trees in New York in 1938–40 to determine the relation between the quantity of petroleum oil deposited on the bark in sprays, as determined by analysis of a sample of twigs [*cf. R.A.E.*, A **30** 121], and the control of the eggs of *Tortrix* (*Cacoecia*) *argyrospila*, Wlk., *Lygidea mendax*, Reut., and *Anuraphis roseus*, Baker. Most of the sprays were applied in spring, while the trees were still dormant. A direct relation was found between the quantity of oil deposited and the toxicity of the sprays to the eggs of *T. argyrospila*, the minimum effective deposit of the oil used in most of the tests being approximately 1·3 mg. per square inch of bark ; different quantities would be required for other petroleum oils. Although oil deposition may be considerably affected by the kind and amount of emulsifying agent used in the spray mixture, little evidence was

obtained of any important effect of the wetting and spreading properties of the emulsifier on the effectiveness of the spray. Sprays of dinitro-ortho-cyclohexylphenol, dinitro-o-cresol and sodium dinitro-o-cresylate showed little or no evidence of toxicity, either when used alone or when combined with oil. Eggs of *T. argyrospila* parasitised by *Trichogrammatomyia tortricis*, Gir., showed essentially the same reaction to the various treatments as unparasitised eggs, though there were indications that some parasites might survive the minimum dosage of oil effective against *Tortrix*.

Approximately 1·5 mg. oil per sq. in. of bark appeared to be the minimum effective deposit for the control of the eggs of *L. mendax*, but formulae recommended against *Tortrix argyrospila* should usually prove effective against this Capsid. The wetting and spreading effect of the emulsifier is, however, more important, since the eggs are deeply inserted in the twigs and greater penetration of the insecticide is necessary. The dinitro compounds were ineffective whether used alone or with oil.

Dosages of oil that were effective against the other two insects were ineffective against *A. roseus* in 1939, when an outbreak of the Aphid occurred. Trees that received a deposit of 1·57 mg. oil per sq. in of bark had 45·73 per cent. of their fruits injured by the Aphid, as compared with an average of 2·53 per cent. on trees treated with the dinitro compounds and retaining a smaller oil deposit.

Fulton (R. A.) & Nelson (R. H.). **Compatibility of Bordeaux Mixture and Cube.**—*J. econ. Ent.* **34** no. 5 pp. 647–649, 6 refs. Menasha, Wis., 1941.

Since rotenone-bearing insecticides are known to become less toxic in the presence of alkalis, owing to the oxidation of rotenone and deguelin, a study was made of the effect of Bordeaux mixture, which is neutral or slightly alkaline, on the constituents of ground cubé root. Cubé yielding 5·7 per cent. rotenone and 24·5 per cent. total extractives was added to Bordeaux mixture (4 : 6 : 50) to make a spray containing 0·015 per cent. rotenone. The suspension was stored in glass bottles, and samples were analysed at monthly intervals.

Analysis by a colorimetric method showed no decrease in the amount of rotenone in the Bordeaux mixture after one hour, 20 per cent. reduction after 30 days, 40 per cent. after 62 days and 50 per cent. after three months, but no further reduction after 12 months, and these results were corroborated by tests on goldfish and larvae of *Epilachna varivestis*, Muls., in the laboratory. A combination of Bordeaux mixture and cubé, originally made up to contain 0·02 per cent. rotenone, but which contained only about 0·01 per cent. at the time of application, tested against *E. varivestis* on beans in the field, appeared equal in toxicity and residual effect to a freshly prepared cubé spray containing 0·015 per cent. rotenone without Bordeaux mixture, possibly owing to the adhesive properties of the Bordeaux mixture and its effectiveness in reducing feeding by *E. varivestis* [*cf. R.A.E.*, A **26** 566; **30** 261].

Livingstone (E. M.) & Reed (W. D.). **The Revival of Cigarette Beetle Larvae fumigated with Hydrocyanic Acid.**—*J. econ. Ent.* **34** no. 5 pp. 653–656, 10 refs. Menasha, Wis., 1941.

Since the time that should elapse between fumigation and determination of mortality of an insect is dependent on many factors, the nature of the fumigant and the susceptibility of the species being among the most important, tests were carried out on the revival of full-grown larvae of *Lasioderma serricorne*, F., after fumigation with hydrocyanic acid gas, to find the time after treatment at which percentage mortality should be determined. Preliminary studies having shown that complete mortality resulted when larvae were exposed to 5, 10 or 15 mg. HCN per litre for 8, 5 or 4 hours, respectively, each of these concentrations of gas was used for 1, 2 and 3 hours, in order that the day-to-day

revival when mortality was low and when it was nearly complete could be studied. It was found that there was a gradual decrease in the percentage revival and some delay in maximum revival for each exposure period as the concentration of the gas increased and at each concentration of gas as the length of exposure increased. The percentage of larvae that revived increased gradually from day to day until the point of maximum revival was reached, and after that there appeared to be little or no relation between revival and time following fumigation. Since both concentration and exposure affected the revival, the selection of an arbitrary time after fumigation for determining mortality is likely to give erroneous results if different concentrations, exposures, or both have been used. The percentage kill for each concentration and exposure should be determined on the day of maximum revival, since most or all of the mortality occurring before is due to the effect of the fumigant, and most or all of that occurring later is due to natural causes.

The effect on *Lasioderma* larvae of fumigation with sublethal dosages of a mixture of ethylene oxide and carbon dioxide (1 : 9) in a partial vacuum is also described. In this case, there were two peaks of revival, the higher one immediately after fumigation, believed to be due to the slow action of the gas, and the other, after some days of lower revival due to the cumulative effect of the poison.

DICKINSON (B. C.), MEADOWS (C. M.) & WITMAN (E. D.). **Sulfur as a Stomach Insecticide.**—*J. econ. Ent.* **34** no. 5 pp. 656–659, 3 figs., 2 refs. Menasha, Wis., 1941.

In view of the favourable results obtained by MacLeod from the use of sulphur as a stomach poison for larvae of *Malacosoma americana*, F. [*cf. R.A.E.*, A **26** 542] and correspondence from him indicating that similar results were obtained with *Tenebrio molitor*, L., and cockroaches, tests were carried out in the laboratory in which several brands of commercial sulphur were applied to foliage in sprays or dusts and ingested by last-instar larvae of several species of insects. *Estigmene acraea*, Dru., *Hyphantria cunea*, Dru., *Epilachna varivestis*, Muls., *Leptinotarsa decemlineata*, Say, and *Ceratomia catalpae*, Boisd., were unaffected by heavy dosages, but wettable sulphur, applied as a spray or dust and dusting sulphur and flowers of sulphur applied as dusts gave heavy mortality of *Laphygma* (*Prodenia*) *eridania*, Cram. (100 per cent. in larvae that ingested 1·5 mg. sulphur), and dusting sulphur and wettable sulphur (in a spray) gave considerable mortality of *Peridroma* (*Lycophotia*) *saucia*, Hb., and *Laphygma frugiperda*, S. & A., respectively. The symptoms are described.

In further tests of different fractions of crystalline sulphur, ground with or without added impurities, and amorphous sulphur against *L. eridania*, only the last gave mortality comparable to that produced by the commercial samples, possibly because it was more finely divided than the others, because it may have contained unidentified impurities, or because amorphous sulphur, insoluble in carbon bisulphide, may be inherently more toxic than crystalline sulphur, soluble in carbon bisulphide.

KAGY (J. F.). **The relative Toxicity of some 2, 4-Dinitro-6-R-Phenols.**—*J. econ. Ent.* **34** no. 5 pp. 660–669, 3 figs., 21 refs. Menasha, Wis., 1941.

The following is based on the author's summary. An investigation concerned with the relative toxicity to several species of insects and mites of some 2, 4-dinitro-6-R-phenols, in which R represents a hydrogen atom or certain alkyl or alicyclic groups, is reported.

The chemistry of the 2, 4-dinitro-6-R-phenols is very similar, but the physical properties vary considerably. From a review of the literature and from the

additional data presented, it can almost certainly be concluded that 2, 4-dinitrophenol is considerably less toxic to insects and mites than 2, 4-dinitro-6-methylphenol (3, 5-dinitro-ortho-cresol). In the study of the compounds as stomach poisons, some relations of structure to toxicity are pointed out. An increase in the length of the normal alkyl chain up to six or seven carbon atoms resulted in a progressive increase in toxicity of the compounds to silkworms (*Bombyx mori*, L.). The normal octylphenol was less toxic than either the *n*-heptylphenol or the *n*-hexylphenol, and this evidence indicated a further decrease in toxicity with an increase in length of the alkyl chain beyond eight carbon atoms. The *n*-hexyl and *n*-heptyl derivatives, which were the most toxic compounds tested, were about twelve times as toxic as the methyl derivative, which is the initial member of the series. The cycloalkylphenols were less toxic than their respective analogues, although the difference was not numerically large; the cyclohexylphenol was about seven times as toxic to *B. mori* as the methylphenol. All the phenols were more toxic to *B. mori* than acid lead arsenate, but less toxic than rotenone; the cyclohexylphenol was more toxic than the cyclopentylphenol to larvae of *Vanessa* (*Cynthia*) *cardui*, L., and *Leptinotarsa decemlineata*, Say.

When dissolved in petroleum oil, the cyclohexylphenol was more toxic than the methylphenol to *Aspidiotus perniciosus*, Comst., *Aphis rumicis*, L., and newly hatched larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., but the petroleum-oil solutions were not significantly different in toxicity to eggs of *Lygaeus kalmii*, Stål, though both were much more toxic than petroleum-oil solutions of 2, 4-dinitrophenol. In laboratory tests with some of this group of phenols in dust mixtures for the control of the citrus red mite (*Paratetranychus citri*, McG.) the determination of the lethal deposits on fruit surfaces showed that the cyclohexylphenol was about three, four and eight times as toxic as the ethylphenol, the methylphenol and 2, 4-dinitrophenol, respectively. Dinitro-α-naphthol was not measurably toxic to this mite. These laboratory results were confirmed by field studies.

The lack of marked specificity in the toxic action of the cyclohexylphenol to insects is discussed. The peculiarities of the toxic properties of the methylphenol among diversified groups of insects and mites are to be expected from the fact that it is the first member of the series. Certain literature relative to the pharmacology and toxicology of the 2, 4-dinitro-6-R-phenols is reviewed; from present information it appears that the order of toxicity of the compounds to man is possibly in the reverse order to their toxicity to insects and mites.

LARSON (N. P.). **Mexican Bean Beetle in South Dakota.**—*J. econ. Ent.* **34** no. 5 p. 669. Menasha, Wis., 1941.

It is recorded in this note that *Epilachna varivestis*, Muls., was found for the first time in South Dakota in August 1941. The larvae and adults were feeding on beans at a point about 8 miles east of Wyoming and midway between Nebraska and North Dakota.

MACKIE (D. B.). **Application of Commodity Treatments for the Alleviation of Quarantines.**—*J. econ. Ent.* **34** no. 5 pp. 670–675, 1 ref. Menasha, Wis., 1941.

The author discusses the methods of treatment, particularly the application of heat or cold and fumigation, that render permissible the entry into the United States or the interstate movement of products that would otherwise be prohibited owing to the risk of spreading insect pests. He deals mainly with fumigation with methyl bromide and the effect of treatment on living plants.

KARR (E. H.). **Experiments with several Wetting Agents in the Removal of Fluorine Spray Residue from Apples sprayed with natural Cryolite.**—*J. econ. Ent.* **34** no. 5 pp. 676–684, 2 figs., 19 refs. Menasha, Wis., 1941.

The following is the author's summary. Experiments were made on the removal of fluorine spray residues from fruit sprayed with natural cryolite. Each of the following wetting agents: soap bark [*Quillaia saponaria*] extract, Intramine-Y, Nekal BX, Vatsol, and Hydralene, was used in either the sodium silicate or the hydrochloric acid solution of a double process washing schedule.

The sodium silicate concentration was maintained at 9·6 per cent. by weight of the actual compound in the solution used for the first washing treatment. The hydrochloric acid concentration in the solution used for the second washing treatment was maintained at 1·5 per cent. actual HCl by weight. Every sample of fruit was exposed to each washing solution for 40 seconds at a temperature of 110°F. in a positive control, experimental fruit washer of a flotation type.

The addition of either soap bark, Intramine-Y, Nekal BX or Vatsol to the sodium silicate solution did not cause any particular change in the result obtained by the dual washing treatment. When Hydralene was added to the sodium silicate solution, the effectiveness of the washing treatment was noticeably lowered. The addition of any one of the wetting agents to the hydrochloric acid solution reduced the effectiveness of the washing treatment. With the exception of soap bark, this reduction in effectiveness was considerable.

ROARK (R. C.). **Present Status of Rotenone and Rotenoids.**—*J. econ. Ent.* **34** no. 5 pp. 684–692, 24 refs. Menasha, Wis., 1941.

The author emphasises the rapid increase in the importation into the United States of derris root, cubé and timbo since they were first commercially introduced, and gives a brief review of information on the cultivation of rotenone-bearing plants of the genera *Derris*, *Lonchocarpus* and *Tephrosia*, the insect pests that attack them and the constituents of derris, cubé, timbo and *Tephrosia*. He discusses the effect on man and laboratory animals of rotenone and the rotenoids [*cf. R.A.E.*, A **29** 135], their present use as insecticides and more effective ways of using them; these comprise the use of derris root of high rotenone content in diluted dusts, impregnated and coated dusts, solutions in organic solvents, colloidal suspensions in organic liquids or water and suspensions in air (smokes and artificial fogs), and the addition of synergists to rotenone.

WHITTEN (R. R.), POTTS (S. F.) & FRANCIS (E. H.). **Concentrated Spray applied with an Autogiro for Control of Cankerworms.**—*J. econ. Ent.* **34** no. 5 pp. 692–696, 5 figs., 4 refs. Menasha, Wis., 1941.

In 1936 and 1937, woodland infested by *Paleacrita vernata*, Peck, and *Alsophila pometaria*, Harr., at Morristown, New Jersey, was treated by spraying or dusting from an autogiro or by power spraying from the ground [*cf. R.A.E.*, A **25** 559]. Data are given on the comparative larval feeding and mortality following treatment by the three methods, and on the spray distribution and adherence obtained with the two types of sprayers. The insecticides used comprised a concentrated spray containing 200 lb. acid lead arsenate, 10 U.S. gals. fish oil and 1½ U.S. gals. light paraffin oil per 70 U.S. gals. water, applied at the rate of about 22 lb. lead arsenate per acre, a proprietary colloidal lead-arsenate spray containing lead arsenate equivalent to 11·5 per cent. arsenic (As), applied at about 3·6 lb. lead arsenate per acre, and a dust of lead arsenate impregnated with 14 per cent. by weight heavy paraffin oil, applied at about 33 lb. per acre, all from the autogiro, and a spray of 5 lb. lead arsenate and 20 oz. fish oil per 100 U.S. gals. water, applied at about 27·5 lb. lead arsenate per acre from ground level.

Analysis of leaf samples from the top, middle and base of trees of the principal species present, selected immediately after treatment and after several inches of rainfall, showed that spray deposition was about the same in plots sprayed with the concentrated mixture from the autogiro and from the ground, though the autogiro gave a better deposit on the top of the forest canopy, where much of the larval feeding occurs ; the deposit was low in plots sprayed with colloidal lead arsenate. Adherence was considerably better in the case of the concentrated spray, probably because of better atomisation and the greater proportion of fish oil to lead arsenate. From daily collection of the frass and dead larvae that fell from the trees into trays, it was found that the dust gave considerable control, but drifting of the dust cloud and loss of dust from the foliage by wind prevented this treatment from being entirely satisfactory ; there was more than 13 times as much feeding in the untreated plot and more than four times as much in that sprayed from the ground as in that treated with the concentrated spray from the autogiro, and more dead larvae were recovered in the latter than in either of the others.

WYGANT (N. D.). **An Infestation of the Pandora Moth,** *Coloradia pandora* **Blake, in Lodgepole Pine in Colorado.**—*J. econ. Ent.* **34** no. 5 pp. 697–702, 1 fig., 2 refs. Menasha, Wis., 1941.

The following is substantially the author's summary. An outbreak of *Coloradia pandora*, Blake, on lodgepole pine (*Pinus contorta latifolia*) in the Arapaho National Forest in north-central Colorado was discovered in August 1937. This is the first known record of its building up to outbreak proportions in pure stands of lodgepole pine. In 1938 and 1939, general observations and limited studies were made. This Saturniid has, as a rule, a two-year life-cycle, but a few individuals remained in the pupal stage an extra year. The main emergence of the moths occurs in July of even years. They mate and oviposit very soon after emergence, and the eggs hatch in about 40 days. The larvae go through five instars. They pass the first winter in the second instar on the twigs and reach maturity the following July ; they then pupate in cells in loose mineral soil, at a depth of 1–4 inches, where the second winter is passed. The eggs form in the pupae in the spring and the moths emerge in July.

The outbreak had the aspects of becoming very serious until 1939, when natural control factors greatly reduced the population. There was at least a 50 per cent. mortality of the larvae during the winter of 1938–39, probably from low winter temperatures. A wilt disease killed approximately 60 per cent. of the remaining larvae in the fourth and fifth instars in June and July 1939. The affected larvae turned orange brown and their body contents became fluid. At the time the larvae were entering the soil in July, approximately 43 per cent. of the remaining population were killed by the effects of heat and drought. Only one species of parasite, *Apanteles* sp., was reared. Bears and squirrels fed upon the pupae.

YUILL (J. S.). **Cold Hardiness of two Species of Bark Beetles in California Forests.**—*J. econ. Ent.* **34** no. 5 pp. 702–709, 6 figs., 5 refs. Menasha, Wis., 1941.

The results are given of laboratory investigations carried out over 4 years in California to determine the effect of low temperatures on last-instar larvae of *Dendroctonus brevicomis*, Lec., which attacks ponderosa pine (*Pinus ponderosa*), and *D. monticolae*, Hopk., which attacks several species of pine. Larvae of *D. brevicomis* were obtained from naturally infested trees and those of *D. monticolae* by allowing caged adults to oviposit in small, freshly cut logs of ponderosa pine, sugar pine (*P. lambertiana*) and lodgepole pine (*P. contorta*). The larvae were removed from the plant material and exposed to low

temperatures for two hours, with 15 minutes for cooling, in individual open cells in paraffin wax. It was found that the temperatures fatal to *D. brevicomis* lie within fixed limits. The critical range is from 10 to −2·5°F. for the first generation and for the second and third generations until the beginning of cool weather in late October or early November; it then falls within six weeks to from 5 to −7·5°F., at which it remains until the larvae pupate in spring. The level of resistance developed each winter is constant whether the season is mild or severe. The temperatures fatal to *D. monticolae* do not fall within a fixed range, but cold hardiness exhibits summer and winter conditions; the critical range for larvae taken from sugar pine was from 15 to 7·5°F. in summer and 7·5 to −10°F. in January. Cold hardiness increases gradually from October or November to January or February and decreases gradually in March and April. The critical range appears to change with the severity of the climate [*cf. R.A.E.*, A **25** 410]. Larvae that developed in lodgepole and ponderosa pines were more resistant than those from sugar pine, possibly owing to nutritional factors, since many of them were larger, grew faster and were more vigorous; the difference in resistance was greatest in autumn and least in midwinter and midsummer. The cold hardiness of *D. brevicomis* was practically unaffected by conditioning in the bark at different temperatures, but that of *D. monticolae* was readily affected by temperature. In overwintering larvae of both species, prolonged exposure to a temperature in the upper part of the critical range increased mortality; none of the larvae of *D. brevicomis* that were alive after 6 days at 0°F. was able to reach the pupal stage.

Larvae of *D. monticolae* are rarely, if ever, killed by winter temperatures in California, but those of *D. brevicomis* may be killed by severe cold in winter; cold weather in autumn or spring has little effect. In the north-east of the State, cold spells of such intensity occasionally occur that overwintering larvae of this species are reduced by as much as 65 per cent., but in other areas the winter mortality is never extensive. The beneficial effects of winter mortality of *D. brevicomis* in commercial pine forests depend on the proportion of the population that is destroyed and whether the infestation is increasing or declining. In an outbreak that has begun to decline, high winter mortality would make control measures unnecessary, since the population would soon return to an endemic state through natural agencies, but in an increasing outbreak, the reduction is only temporary.

MICHELBACHER (A. E.), MACLEOD (G. F.) & SMITH (R. F.). **A preliminary Report on Control of the Western Twelve-spotted Cucumber Beetle in Orchards.**—*J. econ. Ent.* **34** no. 5 pp. 709–716, 3 figs. Menasha, Wis., 1941.

Adults of *Diabrotica undecimpunctata*, Mannh.,* have caused serious damage to stone fruits in several localities in California for a number of years, both by direct feeding and by the spread of brown rot [*Sclerotinia*], and losses were so great in the Brentwood area in 1938 that investigations on its control were carried out in 1938–40. The adults apparently migrate to the orchards from uncultivated areas, and prefer trees with dense foliage, such as peach and nectarine, to more open trees, such as apricot. Infestation was light in 1939, but there were heavy populations in 1940, when most of the work was carried out, the largest occurring in orchards adjacent to the uncultivated land in the Brentwood area, where the average population per tree exceeded 700 in some

* The authors state that E. G. Linsley considers *D. undecimpunctata* an earlier available name for *D. soror*, Lec. Mannerheim (1843, *Bull. Soc. imp. Nat. Moscou* **16** 175–314) treated the species as a variety (var. b.) of *D. duodecimpunctata*, F., described it recognisably, recorded it from California and noted that it was the *Galeruca* 11-*punctata* of Eschscholtz (*in litteris*). Apparently, however, the name had not been validated by Eschscholtz and should be attributed to Mannerheim.

orchards. The beetles damage the ripening fruits ; injury to foliage is seldom severe, and green fruits are relatively free from attack. Control measures are therefore necessary only during the ripening period.

Dusts containing pyrethrum to give a pyrethrin content of 0·1 or 0·2 per cent. with 2–3 per cent. Lethane (50 per cent. butyl carbitol thiocyanate) or a special solvent in talc or sulphur, were the most effective of those tested. Pyrethrum dusts to which no special solvent was added were of little value. Mixtures containing 2 or 3 per cent. dinitro-ortho-cyclohexylphenol gave poor mortality and scorched the foliage. It was found that the dusts should be applied at the rate of about 50 lb. per acre and at temperatures not exceeding 63°F. If there is any drift it should be into the area already treated, as a drift into the untreated part of an orchard will knock the beetles from the trees with a sub-lethal dosage, and the trees should be dusted thoroughly from one side only. Under suitable conditions, mortality should be almost complete, and a single application should give protection for at least ten days, though a second may be necessary, owing to migration from untreated areas. If the infestation is heavy, dusting will not give complete protection, but will reduce the numbers of insects and the damage done.

Vinzant (J. P.) & Reed (W. D.). **Type of Wire Screen required for excluding Cigarette Beetles and Tobacco Moths from Warehouses.**—*J. econ. Ent.* **34** no. 5 p. 724. Menasha, Wis., 1941.

As the 18-mesh screen made of wire 0·011 in. in diameter, originally used in tobacco warehouses and factories for protection against insect pests prevented the passage of adults of *Ephestia elutella*, Hb., but was ineffective against those of *Lasioderma serricorne*, F., tests with a number of types of wire screen were made in 1940, and it was found that an opening smaller than 0·0396 in. in width, which can be obtained with an 18-mesh screen of wire 0·02 in. in diameter or with the 20-mesh screen of standard manufacture, was necessary to prevent the passage of the Anobiid. The cost of the different types of screen is discussed.

Reed (W. D.), Brubaker (R. W.) & Pollard (H. N.). **Hogshead Construction as a Barrier to stored-tobacco Insects.**—*J. econ. Ent.* **34** no. 5 pp. 724–725. Menasha, Wis., 1941.

Flue-cured tobacco freed from insect infestation by raising it to a temperature above 160°F., and stored in hogsheads of the usual construction, which may have cracks up to one inch in diameter, and in improved ones in which the number and width of the cracks were much reduced, was exposed between 3rd June and 3rd December 1940 to attack by 4,700 adults of *Lasioderma serricorne*, F., and 1,100 of *Ephestia elutella*, Hb., per hogshead. It was found that the improved hogsheads provided an effective barrier to infestation by *E. elutella*, but give little protection against *L. serricorne*. The damage, especially from *E. elutella*, was considerably greater on the surface of the ordinary hogsheads.

Eyer (J. R.) & Medler (J. T.). **Control of Thrips on Seedling Cotton.**—*J. econ. Ent.* **34** no. 5 pp. 726–727, 1 fig. Menasha, Wis., 1941.

As a result of severe damage to seedling cotton in New Mexico in the spring of 1941 by a thrips identified as *Frankliniella occidentalis*, Perg., sprays consisting of either 2 lb. tartar emetic, with 1 U.S. pint Dowax as a spreader, or 2 lb. of a proprietary sodium antimony lactophenolate, each with 5 lb. brown sugar in 50 U.S. gals. water, were tested during the first week in June. Counts made 1, 2 and about 7 days after treatment showed significant reductions in the

numbers of thrips on the plants in all cases except the first count after the use of the proprietary compound. Examination a week after spraying showed a rapid recovery of treated plants.

SIEGLER (E. H.) & SMITH (L. E.). **Toxicity to the Codling Moth Larva of Phenothiazine prepared with allotropic Forms of Sulfur.**—*J. econ. Ent.* **34** no. 5 p. 727, 2 refs. Menasha, Wis., 1941.

Since the effectiveness of commercial thiodiphenylamine (phenothiazine) as an insecticide has been found to vary considerably, comparative tests were made with samples prepared from crystalline sulphur, amorphous sulphur and equal quantities of the two. The fractions were obtained by extracting commercial sulphur with carbon bisulphide; evaporation of the solution gave crystalline sulphur and the residue from the extraction was regarded as amorphous. The three products, which had the same thiodiphenylamine content, were ground, dissolved in ethyl alcohol and precipitated with water, and the resulting suspension was tested at the rate of 4 lb. thiodiphenylamine per 100 U.S. gals. against newly hatched larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., by the apple-plug method [*cf. R.A.E.*, A **23** 174]. There was no significant difference between the percentages of infested and "stung" apple plugs treated with the three samples.

POOS (F. W.). **On the Causes of Peanut "Pouts."**—*J. econ. Ent.* **34** no. 5 pp. 727–728, 2 figs., 5 refs. Menasha, Wis., 1941.

The widespread disease-like injury to ground-nuts known as "pouts" has for many years been attributed to factors such as soil conditions, boron deficiency, leafhoppers and thrips; it retards the development of the plants until they begin to bloom, after which they outgrow it. Metcalf [*R.A.E.*, A **25** 755] considered that the condition was due to toxins injected by the potato leafhopper [*Empoasca fabae*, Harr.], but injury due to *E. fabae* observed by the author [**26** 609] was readily distinguishable from "pouts." In 1938, *Frankliniella fusca*, Hinds, was found on injured plants from Georgia, and in 1939, *F. fusca* and *F. tritici*, Fitch, were apparently causing "pouts" in Virginia. During June 1941, the injury was observed on ground-nuts in Virginia, the Carolinas and Georgia, and thrips were present in all cases. Immature thrips collected on injured plants in four localities in Virginia and reared, and adults collected from at least two localities in each State were identified as *E. fusca*. In addition, *F. tritici* was found in collections made in Georgia and South Carolina, and other species of thrips may also be involved.

On plants suffering from this form of injury, many terminal buds look black and burnt, but less severe infestation by thrips permits the leaflets to form normally. Under field conditions, as many as 28 immature thrips have been found between the folds of a single unopened leaflet. Much of the feeding consists in rasping the upper epidermis of the leaflet before it unfolds, causing a scarred and crinkled appearance of the irregularly formed leaflets after they have unfolded; the degree of development of the leaflets apparently depends on the stage of growth at which they are attacked and the number of thrips attacking them. Since adults were extremely abundant in the blossoms, it is possible that they may attack these when they appear rather than the terminal buds, thus permitting more rapid growth of the plant, but it is more likely that the adults migrate to other food-plants, or that climatic or other factors are involved.

In three tests in an out-door insectary in June and July 1941, young ground-nut plants showed the injury within a week after adult thrips (collected on

ground-nuts) were placed on them under controlled conditions, whereas similar plants from which the thrips were excluded grew normally. Preliminary attempts to control the thrips by the use of a spray of tartar emetic and brown sugar were unsuccessful, but the tests were started too late to be valid.

MacLeod (G. F.). **Effects of Infra-red Irradiation on the American Cockroach.**—*J. econ. Ent.* **34** no. 5 pp. 728–729, 1 ref. Menasha, Wis., 1941.

The following is substantially the author's summary. An incandescent lamp capable of producing and focusing a large amount of infra-red radiation was used to kill adults of the American cockroach [*Periplaneta americana*, L.]. The insects were killed by exposure of the ventral surface for 2½–4 minutes to radiation from this lamp at a distance of 18 ins. Double this dosage was required to kill the insects when they were treated on the dorsum. When cockroaches were irradiated through a water screen, which removed a large part of the infra-red radiation, none of them was killed.

In an experiment to test the possibility of race death resulting from sub-lethal dosages of radiation, most marked deviations from normal occurred when irradiated females were placed with untreated males. No general trend toward race death as a result of the treatment was apparent. Attempts to kill insects on plants have resulted in injury or death of the plants before the insects were killed.

Entomology and Limnology.—*Rep. Cornell agric. Exp. Sta.* **53** (1940) pp. 126–137. Ithaca, N.Y., 1941.

Field studies in New York State in 1939 by H. H. Schwardt and M. Ramsay showed that overwintered adults of the Mexican bean beetle [*Epilachna varivestis*, Muls.] began to emerge during the last week in May and were present until about 20th July. There was a rapid decline in the numbers of egg-masses deposited in July, and no eggs were found from 22nd July until 4th August, when oviposition by the first generation began. Larvae were present continuously from 19th June, and pupae were first found on 10th July. None of the dusts or sprays commonly used is effective against eggs or pupae, and if only one application is to be made, the best date is probably between the first appearance of the pupae and the disappearance of the overwintered adults, when the majority of the insects are in the larval stage. A dust containing 0·75 per cent. rotenone, applied at about 30 lb. per acre during the second or third week in July, was the most effective of the insecticides tested, and a spray containing rotenone and skim-milk powder was more effective than one of nicotine sulphate in summer-oil emulsion. C. E. Palm and W. D. Wylie state that in laboratory tests with larvae of *Cirphis* (*Leucania*) *unipuncta*, Haw., to determine the most efficient poison and carrier for cutworm baits, sodium fluosilicate and Paris green were the most effective of the insecticides tried, and wheat bran was the best carrier.

Further studies by T. R. Hansberry and L. B. Norton [*cf. R.A.E.*, A **29** 644] have shown that the toxicity of nicotine administered internally is little affected by the form in which it is administered or by introduction into the gut or blood stream of the insect [*cf.* **29** 206]. In the laboratory, nicotine peat containing 0·0125 per cent. nicotine was as toxic to newly-hatched larvae of the codling moth [*Cydia pomonella*, L.] as standard nicotine bentonite containing 0·05 per cent. nicotine, but it may not adhere so well. In tests against the eggs of *C. pomonella*, rapeseed, coconut, sunflower-seed, cottonseed and raw linseed oils were probably not significantly less toxic than petroleum oil, and castor oil and pine oil were more efficient carriers for nicotine than petroleum oil.

In studies on deposits resulting from sprays containing nicotine compounds and oil-nicotine combinations [*cf.* **30** 350], it appeared that the free nicotine evaporated almost completely with the water ; that fatty acids and other weak acids did not fix the nicotine significantly ; that the stronger acids, such as sulphuric acid and pectic acid, showed considerable loss on drying, but retained the remaining residue for a long period ; that bentonite, peat and Aresket fixed the nicotine completely, so far as evaporation was concerned ; and that oils, with the possible exception of castor oil, had little influence on the loss of nicotine from any of the materials tested. Experiments with adults of the cherry fruit-flies [*Rhagoletis cingulata*, Lw., and *R. fausta*, O.-S.] and the apple maggot [*R. pomonella*, Walsh] showed that arsenic attacks the lining of the midgut sufficiently violently to cause death. Reinecke's salt was exceedingly toxic, doses of about one-tenth to one-fourth of the lethal doses of trivalent and pentavalent arsenic invariably killing all three species [*cf.* **30** 349]. Rotenone, phenothiazine (thiodiphenylamine) and xanthone were less toxic than arsenic in laboratory tests.

T. C. Watkins and W. H. Ewart found that sprays of tartar emetic and white sugar controlled the onion thrips [*Thrips tabaci*, Lind.] in the field, though certain spreaders appeared to reduce their effectiveness. Various dusts did not give control. Laboratory analyses indicated that the leaves of the more susceptible varieties of onions contain greater concentrations of reducing sugar than those of the more resistant varieties. W. A. Rawlins and R. E. Olson state that adults of *Pheletes* (*Limonius*) *ectypus*, Say, appeared on 3rd May and were active in flight throughout May, though females were generally not active until the latter part of the month. Most of the eggs were laid during the last two weeks of May and hatched in about 36 days. Since all the newly hatched wireworms died within 22 days unless they could feed on living roots, reinfestation could be prevented by leaving the soil fallow until mid-July. Observations on the migratory habits of the older wireworms in potato fields showed that only about 30 per cent. were in the potato rows on 26th July, previous to the time of tuber setting, and less than 50 per cent. were in the potato hills during August. Late-planted potatoes were again injured less severely than early ones [*cf.* **29** 643, etc.]. Preliminary work on the relation of crop to infestation indicated that oats, which are planted on soil tilled in spring, were more heavily infested than such crops as clover, timothy [*Phleum pratense*], and wheat, which are established during the previous year, so that the land is not disturbed during the oviposition period.

In studies on the relation of sulphur and its compounds to the control of insect pests, T. R. Hansberry, C. E. Palm, G. E. Carman and E. Stafford found that the adhesion of sulphur dusts on glass, wax and several types of leaves varied both in the amount of deposit and in the relative amounts of the different materials on the different surfaces. Certain adhesives, such as blood albumen, bentonite and iron soap, which was formed when a mixture of dry iron salts and soap with the dust came into contact with water, were particularly effective in preventing loss of deposit from sulphur dusts both in the laboratory and in field tests on celery, beans and fruit trees. Naphthalene, applied at the rate of 400 lb. per acre, was the most effective dust tested against the carrot rust fly [*Psila rosae*, F.], but one containing 15 per cent. naphthalene in sulphur, applied at 300 lb. per acre, was almost as good and much cheaper.

Sulphur was included among various dusts tested in the laboratory against *Cydia pomonella*, and when applied alone to apples not exposed to weathering, almost completely prevented the entry of the young larvae. Adhesives were necessary to render dusts effective on apples exposed to artificial weathering in a " rain machine " ; arsenical dusts were the most effective, but sulphur dust with the addition of nicotine and mineral oil was used with some success. In pre-season tests, sulphur dusts containing 2–5 per cent. mineral oil did not injure young apple trees in the greenhouse.

Boyden (B. L.). **Eradication of the Parlatoria Date Scale in the United States.**—*Misc. Publ. U.S. Dep. Agric.* no. 433, 62 pp., 33 figs., 15 refs. Washington, D.C., 1941.

An account is given of the establishment of the date-growing industry in the south-western United States and of the introduction on offshoots of *Parlatoria blanchardi*, Targ. [*cf. R.A.E.*, A **16** 68], which was soon recognised as a menace to successful production. Brief notes are included on the bionomics and economic status of this Coccid, its food-plants and the ways in which it is disseminated. Early methods of control are reviewed and details are given of the development and progress of the two eradication campaigns carried out in 1914–27 and 1928–36, respectively, of which the latter appears to have been completely successful [*cf.* **24** 803]. Heavy infestations of the red date scale, *Phoenicococcus marlatti*, Ckll., still occur, but this Coccid is apparently of no commercial importance [*cf.* **21** 145].

Pierce (W. D.). **Studies of the Sweet Potato Weevils of the Subfamily Cyladinae.**—*Bull. S. Calif. Acad. Sci.* **39** pt. 3 pp. 205–228, 23 figs. Los Angeles, Calif., 1941.

In this review of the weevils of the subfamily Cyladinae, the author recognises three genera, one of which is new. He discusses the identity of the species of *Cylas* attacking sweet potato, and concludes that *C. turcipennis*, Boh., represented by material from the Oriental Region, is distinct from *C. formicarius*, F., and that the name *C. f. elegantulus*, Summers, should be applied to the widely distributed sweet potato weevil, represented by material from the Oriental Region and the New World.

Pierce (W. D.). **A few Remarks on the possible Origin of the Sweet Potato.**—*Bull. S. Calif. Acad. Sci.* **39** pt. 3 pp. 229–230. Los Angeles, Calif., 1941.

The author concludes that since the species of *Cylas* that attack the sweet potato belong to a group of weevils typically of African or Asiatic origin, the plant itself must have originated in Africa or southern Asia.

Muesebeck (C. F. W.). **Two new reared Species of** *Doryctes* **(Hymenoptera : Braconidae).**—*Proc. ent. Soc. Wash.* **43** no. 7 pp. 149–152, 1 ref. Washington, D.C., 1941.

The new species described are *Doryctes ambeodonti*, reared from *Ambeodontus tristis*, F., in New Zealand, where this Cerambycid is an important pest of timber, and *D. parvus*, reared from the Bostrychid, *Dinoderus minutus*, F., in bamboo in Porto Rico. Specimens of the latter Braconid from other countries are present in the United States National Museum, but no definite hosts are recorded for most of them. They include two, however, stated to have been bred from *Lyctus* in Queensland.

Gobeil (A. R.). *Dendroctonus piceaperda* **Hopk. : a detrimental or beneficial Insect ?**—*J. For.* **39** no. 7 pp. 632–640, 13 refs. Washington, D.C., 1941.

The following is substantially the author's abstract. Figures obtained in connection with an outbreak of the spruce bark-beetle which occurred between 1931 and 1934 in Gaspé Peninsula, Quebec, are used to illustrate how, from one view-point, *Dendroctonus piceaperda*, Hopk., appears to be a forest calamity of major proportions, whereas from another the beetle may almost appear to be beneficial. Viewed from one angle, the losses caused by forest insects in a 3-year period, in the Gaspé Peninsula, are estimated as follows : stumpage, $17,259,000 ; local employment, $49,231,000 ; industry, $32,894,000 ; and

fire prevention control, $2,180,000. However, the estimation of damage on this basis is not recommended because while the author recognises that *D. piceaperda* has been responsible for the death of a tremendous amount of timber, he believes that very little monetary value can be placed on that dead material. In general, the role of the spruce bark-beetle can be compared to that of predatory mammals and birds, feeding mostly on surplus populations, and thus preventing diseases and competition.

ISELY (D.). **Methods of Insect Control. Part I.**—2nd edn. revd., $10\frac{3}{4}\times8\frac{1}{4}$ ins., ii+121 pp., multigraph., many refs. Minneapolis, Minn., Burgess Pub. Co., 1941. Price $1.50. **Part II.**—3rd edn. revd., $10\frac{3}{4}\times8\frac{1}{4}$ ins., ii+135 pp., multigraph., many refs. 1942. Price $1.65. (Both these books are post free for payment in advance.)

The subject matter of this book on the methods by which insect pests can be controlled is based on part of a course in applied entomology and is presented as a series of insect problems, each of which requires a different method of control. In each case the essential information regarding the destructiveness and bionomics of the insect is given to explain the basis for the recommendation and the effectiveness of the control afforded by it. Where possible, insects that are important pests in the United States are selected as examples. The first volume deals with indirect measures, including preventive and cultural measures, mechanical methods and biological control and, in addition to a chapter on general principles of insect control, the substance of which is repeated in the second volume, contains short chapters on the estimation of the economic importance of insects and the importance of a knowledge of the seasonal cycles and life-histories of insect pests and of their relationships with their food-plants in devising control measures. The second volume deals with direct control by means of dusts, sprays, fumigation and poisoned baits, and a chapter on quarantine and eradication by governmental regulation is included. There is a bibliography at the end of each chapter.

LITTLE (V. A.) & MARTIN (D. F.). **Cotton Insects of the United States.**—$10\frac{3}{4}\times8\frac{1}{4}$ ins., ii+130 pp., multigraph., 12 figs., many refs. Minneapolis, Minn., Burgess Pub. Co., 1942. Price $2.25. (Post free for payment in advance.)

The authors have summarised in this book the results of the large amount of work that has been done by entomologists on the insects that attack cotton in the United States. The subjects dealt with are mainly their bionomics and control, but information is included on distribution, alternate food-plants and the morphology of the various stages. There are two sections, the first (pp. 1–79) dealing with insects that feed on the squares, flowers and bolls, and the second (pp. 81–127) with those that attack the leaves, stems and roots. About half of the first section is devoted to *Platyedra* (*Pectinophora*) *gossypiella*, Saund., *Heliothis armigera*, Hb., and *Anthonomus grandis*, Boh.

The Tomato Mite.—*Bull. Dep. Agric. Calif.* **30** no. 3 p. 290. Sacramento, Calif., 1941.

Phyllocoptes destructor, Keifer, which was discovered on tomato in 1940 [*R.A.E.*, A **29** 565], has spread rapidly in northern California [**30** 308]. Injury to tomatos first appears in June, is noticeable in late July and August, and continued into October in 1940. Of various dusts tested for control, dusting sulphur was much the most satisfactory ; it protected the plants for 3–4 weeks and caused no scorching even at temperatures as high as 108°F. Some canning firms, however, restrict the use of sulphur by tomato growers, and others allow

its use, but not at a concentration of more than 25 per cent. In such a case, a mixture of calcium arsenate and 25 per cent. sulphur, applied at the rate of 25–30 lb. per acre, should reduce damage due to the mite and also control hornworms [*Protoparce*] and other Lepidopterous larvae. If the mixed dust is applied against *Protoparce* in July and August, it is probable that an infestation of mites will not develop.

Wilson (C. C.) & Keifer (H. H.). **A Study of the Marginate Grasshopper, with Notes on associated congeneric Species.**—*Bull. Dep. Agric. Calif.* **30** no. 3 pp. 291–311, 5 pls., 2 figs., 15 refs. Sacramento, Calif., 1941.

Melanoplus marginatus, Scud., is restricted to California, where it occurs mainly in the valleys and is commonest in lucerne fields with heavy loam soils at altitudes of 58–450 ft. It occasionally destroys the fourth crop of lucerne in the Sacramento valley, and has also caused damage to fruit trees and beans. Descriptions of all stages are given. The eggs are laid in June–October, in lucerne fields and in grazing land at a depth of $\frac{3}{4}$ to 1 inch, and do not hatch until the following spring. Hatching depends primarily on the humidity of the soil when its temperature reaches a mean of 57°F. When moisture is sufficient, the eggs hatch in the last week of April, but hatching may extend to June. Adults begin to oviposit about 18 days after emergence, and egg-laying continues from early June to the end of October. In the laboratory, development from hatching to the adult stage lasted 63–76 days, and adults lived for 43–106 days. When the lucerne is cut, the grasshoppers migrate to adjacent uncut fields, temperatures above 100°F. being conducive to increased activity. Migration is not influenced by wind, but migrating grasshoppers are attracted by green vegetation. Maximum feeding occurs between 6.30 and 9.30 a.m., at temperatures ranging from 70 to 85°F., but in the afternoon feeding was observed at 94°F. Natural enemies include wild birds, fowls, skunks and insect predators, and *Sarcophaga hunteri*, Hough, *S. kellyi*, Aldr., and *S. opifera*, Coq., are important parasites. Keys to the instars and to associated species of the genus *Melanoplus* are given, and the usual control measures are recommended. Baits should be broadcast early in the morning when the soil temperature is between 60 and 75°F.

Campbell (R. E.). **Further Notes on the Blue Oat or Pea Mite, *Penthaleus major* (Duges), in California.**—*Bull. Dep. Agric. Calif.* **30** no. 3 pp. 312–314, 2 refs. Sacramento, Calif., 1941.

This paper is based on a manuscript written some years ago to record observations on a mite that damaged young pea plants in Alameda County, California, in the winters of 1912–1916. The manuscript was recently submitted to E. O. Essig, who considers the mite to be *Penthaleus major*, Dugès, which he subsequently found on peas further south in California [*cf. R.A.E.*, A **28** 346]. In Alameda County, the mites were observed feeding on self-sown oats, clover, wild mustard and lupin, but seemed to prefer the tender leaves and new shoots of peas, which were attacked until they were six inches high. The plants usually recovered unless the damage was very severe, but the quantity and quality of the crop were affected. In the laboratory, seven individuals laid 20–58 eggs each in oviposition periods of 9–25 days, among soil particles or near the base of the plant stems; eggs were found in the same positions in the field. The mites probably aestivate in the egg stage, on or near the roots of dead grass, and hatch soon after the early rains. In 1915, the first young mites were observed on 29th November; they were numerous by January, but the most serious infestation occurred during February, when the presence of many young mites indicated a new generation. On 15th March young mites were again numerous, suggesting the possibility of a third generation. The population

then decreased, and by 20th April the mites had disappeared. They feed chiefly in the morning and evening on the lower surfaces of the leaves, and hide in the soil during the heat of the day.

WALTER (E. V.). **The Biology and Control of the Sorghum Midge.**—*Tech. Bull. U.S. Dep. Agric.* no. 778, 26 pp., 8 figs., 13 refs. Washington, D.C., 1941.

A more detailed account than one recently noticed [*R.A.E.*, A **30** 170] is given of the life-history and control of the sorghum midge, *Contarinia sorghicola*, Coq., in the south-eastern United States, with notes on the life-history of its parasite, *Eupelmus popa*, Gir., which follows that of the host very closely [*cf.* **17** 376]. In experimental plots, the Cecidomyiid attacked different varieties of sweet and grain sorghum, as well as Sudan and Johnson grass [*Sorghum sudanense* and *S. halepense*] and broom corn, to nearly the same degree; it appears that it oviposits on purpletop (*Triodia flava*) fairly readily when other food-plants are scarce, but that very few individuals develop. A single example has been reared from common foxtail grass (*Setaria lutescens*), which is of European origin, but no oviposition was obtained on other grasses tested under cage conditions and no emergence occurred from grasses collected in the field. In the old world, *C. sorghicola* has been recorded from Italy and the Anglo-Egyptian Sudan [*cf.* **24** 441], and a species described as *C. caudata*, Felt, has been found on native grasses in India. Since this species causes the same type of injury to sorghum as *C. sorghicola*, has a similar life-history and is attacked by the same parasites [*cf.* **10** 422], specimens from southern Baluchistan were compared with adults of *C. sorghicola* reared in the United States. No constant differences were found, and although breeding experiments have not been carried out, it is considered that *C. caudata* is identical with *C. sorghicola*, and that the species possibly originated in southern Asia.

Observations in Texas showed that the spring emergence of the overwintered generation is stimulated by moisture and occurs 10–22 days after a fall of rain, depending on the temperature during the intervening period, and that there are usually 13 generations during the growing season. The proportion of males to females was 44·7 : 55·3 from overwintered larvae and 35·6 : 64·4 from others. The dormant larvae may be carried long distances in the seed or hay of the food-plants; the adults can migrate only short distances by flying. The newly emerged midges and the ovipositing females are attacked by a number of predators, of which ants and spiders found on the sorghum heads are the most active.

MUNRO (J. A.) & TELFORD (H. S.). **Grasshopper Control aided by Tillage Methods.**—*Bull. N. Dak. agric. Exp. Sta.* no. 309, 14 pp., 3 refs. Fargo, N. Dak., 1942.

Investigations on the control of the eggs of grasshoppers, chiefly *Melanoplus mexicanus*, Sauss., in North Dakota by various methods of soil tillage were begun in 1939 [*cf. R.A.E.*, A **27** 655] and continued until 1941. The percentages of egg mortality (estimated by comparing the number of eggs per unit area before tillage with the number of hoppers that hatched after tillage) were 96 for moldboard ploughing in autumn, 90 for one-way disk ploughing in autumn, 86 for double disking in autumn, 83 for moldboard ploughing in spring, 73 for duckfoot cultivation in autumn, 69 for one-way disk ploughing in spring, 58 for duckfoot cultivation in spring, and 40 for double-disking in spring. Ploughing as used in preparing land for summer fallow is a valuable aid in control if done at about the time that the normal hatching period is nearing completion in June, provided that it is begun round the outer margin of the field and proceeds inwards, so as to force the hoppers to concentrate on a narrow strip of vegetation, on which they can be poisoned. Tillage, applied just before egg-laying,

was found to repel ovipositing grasshoppers and to discourage them from laying eggs in the tilled area. Although autumn ploughing gives the best grasshopper control, it exposes the fields to wind erosion, and where the latter is to be guarded against, one-way disk ploughing, or double disking, is to be preferred. Fields cleared of grasshoppers may be invaded from surrounding areas, and experiments in which hoppers were released in the middle of tilled areas showed that when the air temperature is 75°F. and the soil surface temperature 90–95°F., hoppers tend to migrate against the wind, the average maximum speed of migration being 4 feet per minute.

PICKLES (A.). **Scale Insects of Cocoa.**—*Proc. agric. Soc. Trin. Tob.* **41** pt. 3 pp. 579–581, 583–584. Port-of-Spain, 1941.

The author records two recent cases of infestation of young cacao trees in Trinidad by the Coccids, *Howardia biclavis*, Comst., and *Asterolecanium pustulans*, Ckll. The former occurs beneath the outer bark near the base of twigs or branches and causes shedding of the lower leaves, while the latter occurs near the tips and causes local swellings and the shedding of the upper leaves. Both cause dieback of the affected branch and possibly the death of young trees or of large portions of older ones if the infestation persists. Possible methods of controlling the outbreaks, which may have arisen as a result of two successive dry seasons and may cease to be of economic importance when the weather becomes normal, are discussed.

RAMAKRISHNA AYYAR (T. V.). **Handbook of economic Entomology for South India.**—Roy. 8vo, xviii [1]+528 pp., col. frontis., 413 figs., 8 pp. refs. Madras, Govt. Pr., 1940. Price *Rs.* 5–8–0. [Recd. 1942.]

This work, which brings up to date the information given in an earlier one by T. B. Fletcher [*R.A.E.*, A **3** 146], is designed for the use of agricultural students and farmers in South India. The subject matter is based on a students' course in entomology, and it is arranged in two sections, of which the first (pp. 1–85) comprises a brief account of the general principles of entomology and the second (pp. 86–463) deals with insects of economic importance in South India. This section contains chapters on methods of control, beneficial insects, household pests, insects of medical and veterinary importance and pests of stored products, but the bulk (pp. 151–393) is devoted to the bionomics and control of agricultural pests, arranged under the crops attacked. There are five appendices, in which are given a systematic list of South Indian pests with their chief food-plants, a summary of insect classification, notes on entomological technique, together with formulae for sprays, dusts, baits, etc., notes on agricultural pests other than insects and insectivorous animals of importance, and a bibliography of works on insect pests of South India. The book is copiously illustrated.

CHERIAN (M. C.), KYLASAM (M. S.) & KRISHNAMURTI (P. S.). **Further Studies on *Calocoris angustatus* Leth.**—*Madras agric. J.* **29** no. 2 pp. 66–69, 2 refs. Madras, 1941.

Calocoris augustatus, Leth., is a pest of grain sorghum (*Sorghum vulgare*) in various parts of the Madras Presidency and also occurs in other provinces of India. Apart from Madras, however, the only record of injury by it has been in Mysore in 1936. Investigations on its bionomics carried out during 1934–37 showed that infestation at Coimbatore, where there is an interval in July between successive crops of sorghum, is much more severe on the irrigated crop (April–June) than on that grown during rainy weather (August–January). At Guntur, where overlapping crops are growing from June to February,

infestation on early sorghum (June–September) is heaviest at about mid-September. In both districts, the Capsids first appear when the ears emerge from the leaf sheaths, and during the following fortnight large populations of nymphs are built up, as many as 350 occurring on a single ear in years of heavy infestation at Coimbatore ; about a week later, the population drops considerably. It is thought that breeding occurs exclusively on the ears ; adults are present within the spindles from September onwards at Coimbatore, but they are not known to breed until the ears appear in mid-October. In both districts, varieties of sorghum with compact ears are more severely attacked than those with loose ears. If the ears are attacked before they emerge from the sheaths, they become red in colour and covered with a gummy exudation, and no grains are formed. Damage is somewhat less severe on ears that are attacked after emerging, and very slight on those attacked after the grains begin to harden. The life-cycle occupied about two weeks at Guntur in 1935, and there is generally time for only one generation to develop on the ears before they harden ; when this happens, the second generation nymphs feed on the main stalks.

Preliminary experiments on control carried out in 1936 with a proprietary sulphur dust were encouraging, but statistical data obtained during further experiments with the dust in 1937 showed that the differences in yield and populations between untreated plants and those receiving one or two applications of dust, the first immediately after the emergence of the ears or 4 or 8 days later, and the second after an interval of 6 days, were not significant. Experience indicated, however, that one application on the eighth day after the emergence of the ears, with or without a second six days later, gave about the best results, and a single application at the rate of about 35 lb. sulphur dust per acre on the eighth day is recommended.

MONRO (H. A. U.). **Vacuum Fumigation for Insect Control.**—*Sci. Agric.* **22** no. 3 pp. 170–177, 3 figs., 15 refs. Ottawa, 1941.

This general account of vacuum fumigation for the control of insect pests includes a discussion of the basic theory, the effect of vacuum fumigation on insects and on commodities, and equipment. The process is used when special circumstances require increased effectiveness, penetration or speed. Of the two methods commonly in use, that in which air is not admitted into the evacuated vault until after the period of exposure is completed is generally more effective as regards insect mortality than that in which the air is introduced with, or soon after, the fumigant, until atmospheric pressure is almost or quite restored ; it cannot be applied at low pressures, however, to those plants, fruits and vegetables that are too delicate to withstand them.

The rapid removal of residual gases by introducing air until normal pressure is almost reached and then pumping out the mixture of air and fumigant is generally considered to be an advantage of vacuum fumigation, but the author considers this method to be no more effective in removing gas from the air space than efficient exhaust fans, and its effectiveness in removing the fumigant from some commodities has not been definitely established ; the concentration of hydrocyanic acid gas in the centre of bales of cotton has been shown in a paper already noticed [*R.A.E.*, A **27** 53] to increase after one air washing.

The author emphasises the desirability of expressing degree of vacuum as inches of absolute mercury pressure, so that a given figure would be uniform whatever the atmospheric pressure.

Mediterranean Fruit Fly, Season 1939–40.—*Agric. Bull. Palestine* April–June 1941 pp. 202–204. [Jerusalem] 1941.

Temperatures were in general moderate and humidities high in Palestine during and after the *Citrus* season of 1939–40, and the Mediterranean fruit-fly

[*Ceratitis capitata*, Wied.] continued to be active until the second week in January 1940 in the inner plains, where 25 per cent. of the grapefruit crop was attacked, but ceased its activities in the coastal plain very early in the season. It caused considerable damage to late Valencia oranges and apricots in spring and attacked plums and peaches continuously and heavily throughout the summer.

Bait sprays containing 6 or 8 oz. copper carbonate and 50 oz. sugar or 3 oz. sodium fluosilicate and 100 oz. sugar in 50 pints water, applied to grapefruit trees from October to November and from 20th February, after the main rains, until picking, reduced the percentage of fruits attacked from 8·2 to 0·3, 1·8 and 0·9, respectively. Similar mixtures, with lime and ammonium bicarbonate or lime and zinc sulphate incorporated in the copper carbonate sprays and magnesium oxide in the sodium fluosilicate sprays to prevent scorching, reduced the injury to apricots from 33 to 10 per cent. until the third week of picking, when the number of flies increased so much that the sprays were inadequate and infestation in both treated and untreated plots rose to 79–80 per cent. The first mixture, with the addition of 8 oz. ammonium bicarbonate and 12 oz. slaked lime per 50 pints in humid areas, applied as a cover spray every seven days until the fruit approaches maturity, when the interval should be reduced to five days, is recommended as a general spray, and the periods over which each kind of fruit should be protected are given.

Papers noticed by Title only.

Sullivan (W. N.), Goodhue (L. D.) & Fales (J. H.). **Application of the Aerosol to Fumigation. I. Stabilization of a Naphthalene Aerosol.**—*J. econ. Ent.* **34** no. 5 pp. 650–653, 1 fig., 11 refs. Menasha, Wis., 1941. [See *R.A.E.*, B **30** 111.]

Smith (Edwin), Ryall (A. L.) & Cassil (C. C.). **Some hot Washes needed** [for removal of lead and arsenic residues from apples] **if Spray Program heavy.**—*Bett. Fruit* **36** no. 4 pp. 12, 14. Portland, Ore., 1941. [*Cf. R.A.E.*, A **30** 308.]

Stanley (J.). **A mathematical Theory of the Growth of Populations of the Flour Beetle** *Tribolium confusum* **Duv. V. The Relation between the limiting Value of Egg-populations in the Absence of Hatching and the Sex-ratio of the Group of Adult Beetles used in a Culture.**—*Ecology* **23** no. 1 pp. 24–31, 1 graph, 2 refs. Lancaster, Pa., 1942. [*Cf. R.A.E.*, A **29** 450.]

DeLeon (D.). **Notes on some Forest Insects found in** *Pinus occidentalis* **Swartz near Jarabacoa, Dominican Republic.** [A list of 36 species.]—*Caribb. Forester* **3** no. 1 pp. 42–45. Río Piedras, P.R., 1941. (With a Summary in Spanish.)

Cherian (M. C.) & Anantanarayanan (K. P.). **The Coconut Palm Beetle** [*Oryctes rhinoceros*, L.] **and its Control** [in India].—*Indian Fmg* **2** no. 3 pp. 130–131, 2 pls. Delhi, 1941. [*Cf. R.A.E.*, A **28** 205.]

[Skoblo (I. S.).] **Скобло (И. С.). The Ecology of** *Habrobracon* [*Microbracon*] *brevicornis* **and its Use as a Parasite of the Corn Ear Worm** [*Heliothis armigera*, Hb., on cotton in Azerbaijan]. [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 5 pp. 67–75, 1 graph. Leningrad, 1941. [For Summary see *R.A.E.*, A **30** 25.]

Steinhaus (E. A.). **A Study of the Bacteria associated with thirty Species of Insects** [in Ohio].—*J. Bact.* **42** no. 6 pp. 757–790, 17 refs. Baltimore, Md., 1941.

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